SCIENTIFIC AMERICAN

SMOKE
By George T. Moore, Ph.D.

"MESSAGES" FROM THE SUN

MAPPING ON THE WING

MEASURING FOOD ENERGY—PAGE 339

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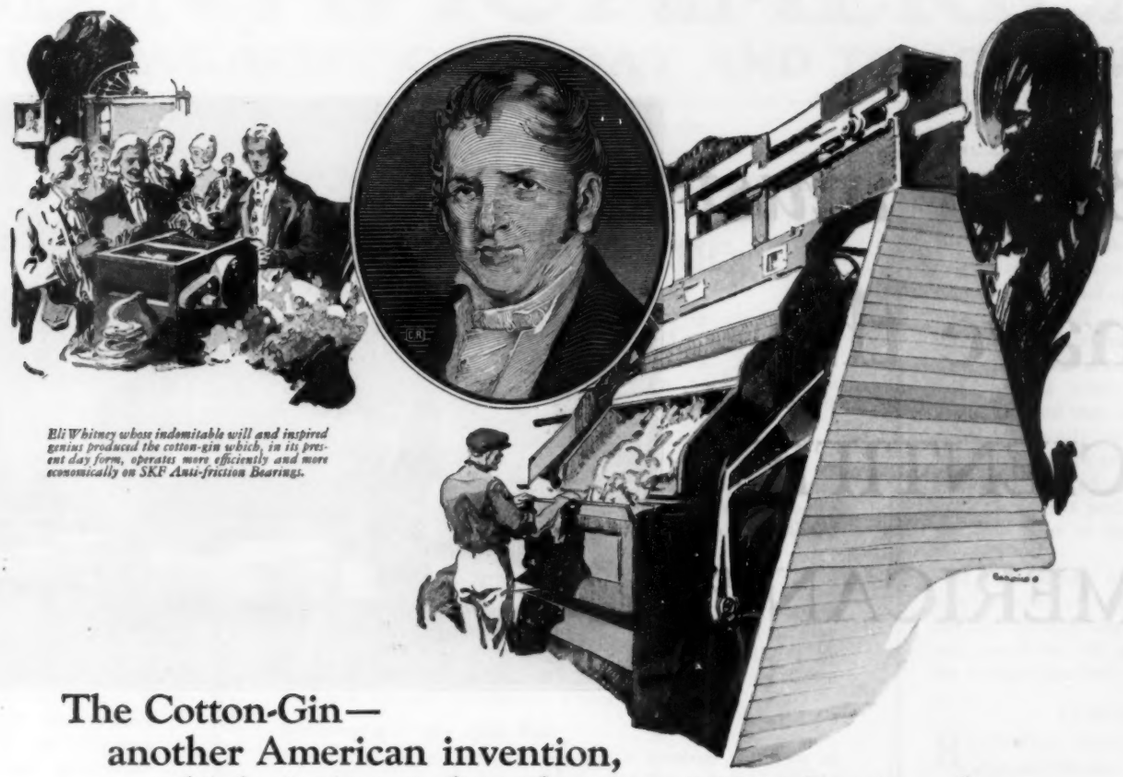

Eli Whitney whose indomitable will and inspired genius produced the cotton-gin which, in its present day form, operates more efficiently and more economically on SKF Anti-friction Bearings.

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SCIENTIFIC AMERICAN

THE MAGAZINE OF TODAY AND TOMORROW

NEW YORK, MAY, 1927 — *Edited by* ORSON D. MUNN — EIGHTY-THIRD YEAR

PREMATURE

ONE or two of our states have laws providing for the compulsory sterilization of habitual criminals. Frequently one hears the argument that this law should be adopted in every state. Often, when we realize that most of the crime is committed by about one percent of the population—the hereditary criminal class—we feel like seconding the motion—"Sterilize 'em all and get rid of crime."

But we are against this law, not because we wish to drink a toast to crime, but because we do not believe science has enough knowledge of heredity yet to warrant putting the change into practice. The complete extirpation of every living criminal would not put an end to inherited criminal tendencies. For most of us are carriers of latent criminal tendencies, passed down to us from somewhere 'way back, and capable of being passed on to our offspring or sent down to some later generation.

While the science of genetics is still so young and uncertain the state authorities should look before they leap.

APPLES

A LONDON greengrocer has just been fined one pound and ordered to pay costs for selling American apples containing lead arsenate. This chemical is used as a spray to kill worms that spoil apples. In the London case it was found by the prosecuting lawyer that there was .05 grain of lead arsenate per pound of apples. There was also lead to the extent of .56 grain per pound. This, it was claimed, made the fruit dangerous for human consumption.

Are the American export growers using too much lead arsenate or are the London consumers unduly worried?

FISH

IF you are in Europe this summer and get homesick, take a run up to Lake Fully in Switzerland and catch some good American lake trout.

Lake Fully, at the foot of Dent de Morales, is at an altitude of approximately 6,600 feet. It had never contained fish of any kind until in 1922 the government stocked it with fingerlings, hatched from eyed eggs obtained from the United States Bureau of Fisheries. At the foot of a circle of mountains, where cattle graze in summer, there is plenty of food for the denizens of the lake, with daphnids, boat flies and so on. Being frozen over, however, from November to June, it is too rigorous for the effete fish of Europe.

The sturdy lake trout of our own New England States have solved the problem.

In This Issue

Mapping on the Wing

With an airplane equipped with a special camera you can make fairly accurate maps faster than could a whole regiment of ordinary surveyors working on the ground. This is just how your Uncle Sam has been mapping wild regions in Alaska. The job turned out to be a real adventure replete with the thrills of the 'movies.' See pages 303-04-05.

Smoke Must Go

Industrial engineers know, and the public is beginning to know, that smoke must go. Before many years city smoke will no more be tolerated than smallpox. On pages 322-323 a noted scientist tells what smoke does to vegetation.

A Story with Real Human Interest

Could a deaf man play a musical instrument? A foolish question? It sounds like one, we admit, yet deaf men *do* play musical instruments every day, and play them well. They get lots of fun out of it but no more than you will get if you read how they are instructed. Pages 310-311.

Splitting a Pretty Fine Hair

How could anyone actually measure a hundred *millionth* of an inch? It sounds impossible? Are the scientists fooling themselves? We do not blame you if you are "from Missouri" about this. Yet, when you read how it is done, you will be surprised to see how simple it is. Pages 312-13-14.

MORE THAN 200 PICTURES

Complete table of contents will be found on page 368.

For Next Month

What Price Oranges?

You like oranges but so do a lot of insect pests. Every time the horticulturists develop a new plant, a new bug bobs up and says, "That's mine." Scientists state that man's most dangerous foes on earth are the insects. In the case of oranges the warfare is bitter, interesting, endless. Next month a famous entomologist will present a glimpse of the battle.

Golf—They're Still at It

In the issue of last August, Prof. H. H. Sheldon stated that the golf ball manufacturers could make better balls if they would study science. In December, P. A. Valie, a golf expert, replied that they know more about the science of golf balls than Prof. Sheldon thinks. Next month we will publish, side by side, Prof. Sheldon's rejoinder, and Mr. Vaile's rejoinder to Prof. Sheldon's rejoinder. This controversy is getting interesting. Are you a golfer? Order the next issue now.

Giving a Voice to Motion Pictures

The latest development in motion-picture production that has outgrown the experimental laboratory stage and entered the phase of commercial utility is the accurate synchronization of a voice record with the pictures, and the faithful reproduction of that record in the theater. The first of a series of articles on the methods that are used will appear in our next issue.

Other articles on A Revolution in Locomotive Construction; Preserving Sea Elephants for Posterity; Whaling Out of the Golden Gate; The Manufacture of Scissors; Radio; Astronomy.

MORE THAN 200 PICTURES

WHY?

EVERY year the circulation of the Scientific American, like most other magazines, fluctuates a few thousand between winter and summer. If in summer it eases off a bit, in winter it picks up again, probably because people have more time to read in winter. But this year the winter pick-up has just about doubled that of several previous years. Naturally we are gratified, but we wish we were certain we could explain it. We can assign several possible causes but perhaps we as editors are "too close to the trees to see the woods."

If you are one of the new readers, won't you tell us what trends made you buy the Scientific American, and if you are one of the old won't you pick out the changes you have noticed most?

LUXURY?

RECENTLY, according to *The Iron Age*, the Norton Company, of Worcester, Massachusetts, made a survey of the number of motor cars owned by its 2,900 employees. In all, 740 cars were owned. Of these, 419 were driven to work daily, carrying on the average three employees. Twelve hundred and fifty-seven workmen riding to factory work in motor cars! Some think that is an awful extravagance and that America, like Rome, will fall if this kind of thing keeps up.

But this is not an extravagance, it is an economy. Charge five cents per mile against the car and figure it out: you will find that it costs these men less to get to work in this manner, owing to the saving in time involved, than it would if they walked or rode in a slow public conveyance. The time and energy saved goes toward increased production or increased leisure or both. The saving is therefore worth while.

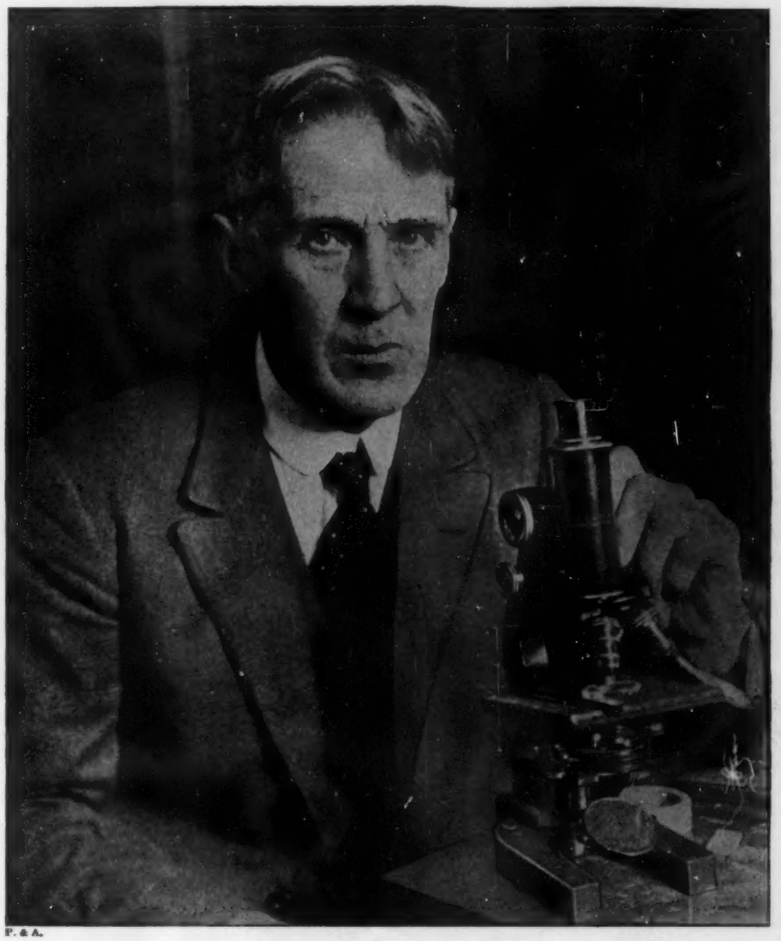
The workman's motor car is certainly not a luxury.

SYMBOLS

REPRESENTATIVE SEARS, of Omaha, introduced a joint resolution in Congress asking that the columbine (aquilegia vulgaris) be designated and adopted by the United States as the national flower.

For many years there has been a tradition that our national flower is the goldenrod. It is understood, however, that members of the United States Hay Fever Association are heartily in favor of a change. Some Republican politicians are said to favor the elephant ear, while a prominent Tammany politician, when asked to express a choice, promptly replied, "The tiger lily."

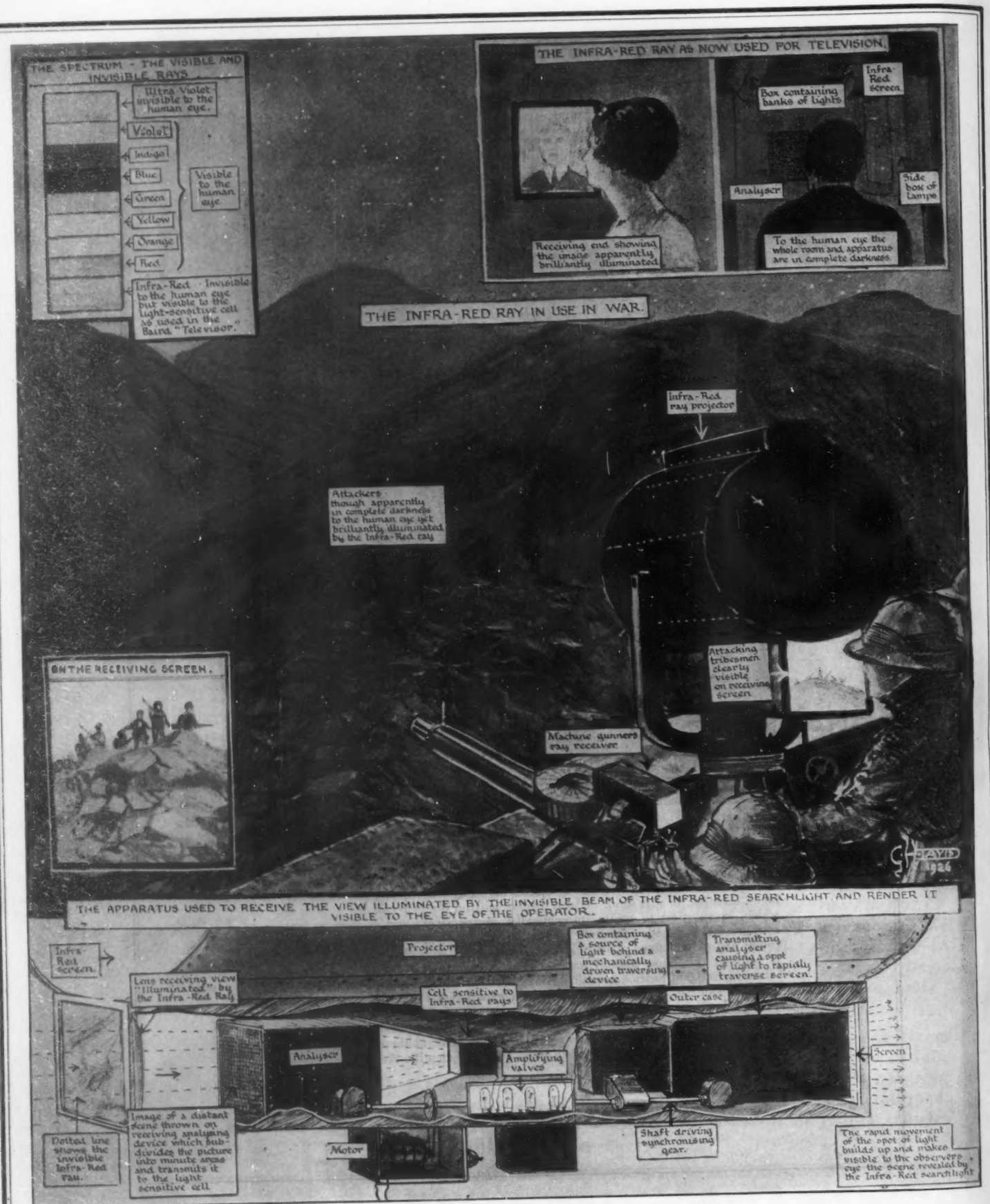
As a compromise, why not adopt the columbine?



F. & A.

Professor Robert W. Wood

One of the most interesting scientists, because he is always doing something new and unusual, is Dr. R. W. Wood of Johns Hopkins University. Dr. Wood is most widely famed for his researches in optics, his "Physical Optics," now out of print, being a classic in that field. Older readers will no doubt recall his experiments in which, in an effort to create automatically, inexpensively and quickly an immense astronomical telescope mirror by the action of centrifugal force, he rotated a large, round pan of mercury. (See Scientific American, March 27, 1909.) At present he is working on "super-sound" waves—waves at too high a frequency to be heard, vibrating 200,000 times a second. Some startling effects have already been demonstrated. But Dr. Wood is not merely an experimental physicist: "The Man that Rocked the Earth," an intriguing piece of scientific fiction, and a book of nonsense verse entitled "How to Tell the Birds from the Flowers," which has had an immense sale, demonstrate that the modern scientist is as human as the rest of us. Recently Dr. Wood promised to write for the Scientific American



Courtesy of the *Illustrated London News*

Secret Vision by the Invisible Infra-Red Ray

How to make the enemy secretly visible at night in time of war is the plan of John L. Baird. The invisible infra-red rays will be projected through the dark, "illuminating" them without their knowledge. But the machine gunner could discern them clearly when provided with special apparatus.

All photographs Official Navy Photos by P. A. McDonough, Alaskan Aerial Survey Expedition

LAKE GRACE, NAMED IN HONOR OF MRS. CALVIN COOLIDGE

This body of water, located on Revillagigedo Island, was discovered by Lieutenant Ben H. Wyatt. It is nine miles long and from four to five miles wide

Alaska Is Mapped from the Air

With Three Airplanes, a Government Expedition Did More Mapping in Alaska in Fifteen Days than Ordinary Surveyors Could Have Accomplished in Fifteen Years

By John L. Von Blon

WITH the most important single step ever taken toward the industrial development of southeastern Alaska, the American Navy has again thoroughly demonstrated its peacetime usefulness in an unusual way.

Having mapped from the sky an extensive area of potentially rich but almost inaccessible territory, much of which human eyes never had seen, discovered great water-power and timber resources, proved the possibility of commercial aviation to and in our far northwest and set new efficiency records, the Alaskan Aerial Survey Expedition is back at the United States Naval Air Station at San Diego.

This photographic exploration force from North Island was the largest and most successful ever sent out by any navy or the air service of any government. The work assigned it, charting with cameras 40,000 square miles of a rugged, remote and partially unknown region, appeared stupendous, but remarkable progress has been made. More than 10,000 square miles of it was mapped by two planes in about 15 days, conditions during the rest of the time having been unfavorable. No similar feat had before been accomplished. Yet so quietly were the operations carried on, that the world heard practically nothing about the undertaking.

Handicapped by lack of adequate maps in its investigation of the mineral and other natural resources of that section of Alaska, and without facilities for aerial work, the Department of the Interior requested the Navy Department to assume this mission. The terrain to be covered stretches 900 miles along the coast northward from Ketchikan to Anchorage and is approximately 60 miles wide. It consists mainly of islands and lies within the Tongass National Forest.

Under command of Lieutenant Ben H. Wyatt, the expedition started from San Diego last May and returned four months later with perfect negatives showing in accurate detail Revillagigedo, Prince of Wales, Annette, Duke, Cravina, Heceta, Mitkof, Zarembo, Tupereanof, Kosciusco, Douglas, Dall, Etolin, Wrangell, Admiralty and other islands and a number of mainland areas. In addition, hundreds of oblique views were made for the Lighthouse Service; for the Forest Service, to determine the quantity, quality and type of timber; for the Roads Commission of the Department of Agriculture; and for the Bureau of Fisheries, which desired photos of its hatcheries and contiguous lakes and streams with the object of extending its activities.

LIEUTENANT BEN H. WYATT, U.S.N.

Officer in charge of the Alaskan Aerial Survey Expedition of the United States Navy Department

At specified points the timber cut along the international boundary also was photographed from the upper air in order to re-establish the line between the United States and Canada and thus dispose of a friendly controversy. Ordinary surveying here would have taken years and cost many thousands of dollars.

On the whole, more daring photography never has been done. A high order of courage was requisite. A forced landing or crash on the vast glacial ice fields among the mighty mountains of the mainland or in the densely wooded interior of any of the larger islands, of which little is known, would have spelled certain doom. Escape or rescue would be impossible despite every precautionary measure.

The filming was a rigorous test of the serviceability of the aircraft, of its ability to operate for long periods away from the home base in the face of many and severe difficulties, and a supreme trial of the aerial mapping method. The men could have had no harder service. Planes and personnel came through with flying colors. Not an accident marred the big job.

The aviation detachment comprised seven officers and 40 men with three planes of the Loening amphibian type, all-metal. The *U. S. S. Gannet*, a powerful mine sweeper assigned as aircraft tender, Lieutenant W. R. Spear commanding, had a crew of five officers and 60 men—a total personnel of 112. At the Puget Sound Navy Yard a 250-ton freight lighter was converted into quarters for the force, and fully equipped to facilitate the activities of the aviation

HEAD OF LAKE TURNER

Airplanes made short work of mapping rough and inaccessible country such as this, found east of Juneau. Rugged heights wall in this extensive body of water

ON THE MAINLAND

This large, picturesque group of lakes was rapidly and accurately mapped by means of airplane cameras. This photograph was taken to the north of Rudyerd Bay

detail with workshops, motor-overhaul plant, complete photographic laboratory, offices and even a loft for the homing pigeons which were carried on all planes to deliver messages to the base in case of difficulty.

This old ammunition barge, 100 feet long, was decked over with wood, with a ten-foot canvas extension over the stern, and was towed thousands of miles by the *Gannet* as a unique floating base and home.

Operations were conducted respectively from Ketchikan, Wrangell, Petersburg, and Thane, near Juneau. Every hour that weather conditions permitted was utilized. Within two and a half hours after arrival of photographic material at Ketchikan, the first mapping flight was under way. Owing to rains, gales and low clouds only one day in ten was suitable. In the late season the low morning and afternoon suns cast such long shadows that satisfactory mapping was out of the question in most localities, but clear "shots" were made up to 10 P.M. All mapping was from 10,000 feet altitude. Much time was devoted to observation flights. R. H. Sargent, topographic engineer, United States Geodetic Survey, was taken on many of these. Mr. Sargent, who is credited with the conception of the idea of mapping Alaska from the air, accompanied the expedition as technical advisor. He has spent 18 years there, surveying by the old methods.

On a mapping run over Revillagigedo Island in the middle of June the commanding officer discovered a beautiful interior lake hitherto unknown. This body of water, nine miles long and four to five wide, was immediately named "Lake Grace" by citizens of Ketchikan for Mrs. Coolidge, and it is understood that official recommendation has been made that it be so designated permanently to honor the mistress of the White House. The lake, at an elevation of about 1,500 feet, has an enormous drainage area and is regarded an important potential source of power for Ketchikan.

Every Tree Can Be Counted

On June 30, after a two-hour special flight with Lieutenant Wyatt, District Forester C. H. Flory, in charge of all the forests in Alaska, stated that every power site on Revillagigedo Island and three on the nearby mainland can be linked in a single system delivering approximately 100,000 horsepower into Ketchikan. The observations disclosed for the first time a large interior valley and low passes leading into it from the island's east and north shores. This makes possible, he believes, cable connections and unification of all transmission lines at a cost as low as 200,000 dollars for installation. So many lakes were seen in a potential power chain that an accurate record could not be made of them, but subsequent mapping operations brought all out in minute detail.

This astonishing hydro-electric revelation, coupled with the fact that southeastern Alaska has an apparently inexhaustible supply of the finest spruce, pine and hemlock timber, is expected soon to result in the erection of huge pulp and paper mills in Ketchikan. Negotiations in that direction are already under way. District Forester Flory declares that plants furnishing employment to thousands of men and having a daily output of 500 to 600 tons of newsprint can be established. He asserts that part of Alaska is able to supply in perpetuity an amount of paper equal to one-third of the present daily consumption in continental United States. Thus would be indirectly influenced the lives of the whole population of the country.

Later the expedition discovered further timber and power resources on that and other islands. The stand of trees generally is so dense that the sun never reaches the ground beneath and the rains keep it constantly wet. Hence reforestation would be a quick process. These finds and the anticipated developments are of moment to all America.

District Forester Flory was enthusiastic over the aid rendered his department. "I learned more about Revillagigedo Island and portions of the mainland in a two-hour flight with Lieutenant Wyatt," said he, "than I ever was able to learn from my own years of observation and the records made by those who preceded me. Many hundreds of thousands of dollars will be saved the government by these operations. Projects which ordinarily require a year for my department to survey can be accomplished in one hour by the planes, which would in the same flight achieve other objects as well. So accurate are the pictures that every tree in timber areas can be counted, timber suitable for mill use and for pulp can be segregated, and much of the work we are now doing at considerable expense eliminated."

An aerological unit was attached to the expedition and proved to be an important factor and the weather information thus obtained was quite accurate and served its purpose. Twice daily, clouds permitting, balloon soundings were made for direction and velocity of the upper air currents, and every day two weather maps were made and the regular

"U.S.S. GANNET"—AIRPLANE TENDER

This photograph was taken when the Gannet was close to Taku Glacier. The wall of ice is 200 feet high

TOWING THE LIVING QUARTERS

The covered barge in the background, serving as living quarters and workshop, was towed thousands of miles

A VIEW OF TAKU GLACIER

Twelve miles of the "river of ice" are visible here. The back-country view discloses 40 miles of territory

report transmitted to the United States Weather Bureau in Seattle and San Francisco. A complete weather log was kept and monthly reports transmitted to the Bureau of Aeronautics. The charts will form a full record for future reference.

In the vicinity of Juneau sudden winds locally termed "williwaws" blow down from the mountaintops with velocities of 50 to 100 miles an hour and are frequently very destructive. Usually they occur on clear days during periods of good weather. It is impossible to forecast them. Especial attention was given to a study of these mysterious disturbances.

One of the planes encountered a comparatively mild "williwaw" while taking oblique photographs at a low elevation over LeConte Glacier and was forced down to within a few feet of the ice. The strong downward current precluded regaining altitude and it was therefore necessary to fly with the throttle fully open. Dropping from an altitude of 6,500 feet, the plane barely skimmed the top of the glacier for a distance of 15 miles until the water's edge was reached. Then for five miles the bay was covered with countless small icebergs which could be topped only by a hair's breadth. The air speed meter indicated 115 miles an hour, yet for 20 miles the "williwaw" bore the plane perilously low. The glacier and bergs are an indescribable blue but the pilot and photographer are supposed to have rivaled them in respect to color-feeling during this nerve-racking flight.

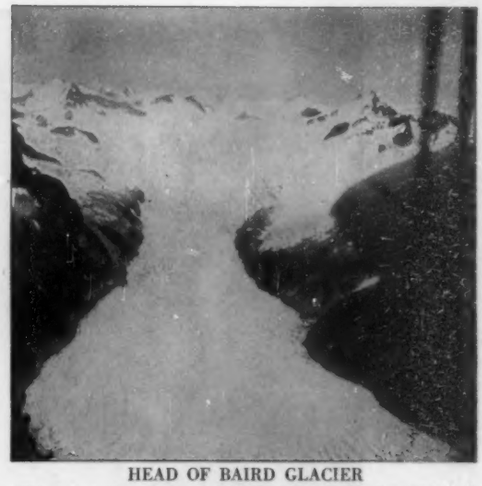
Lieutenant Wyatt, officer in charge, made the highest climb September 8 when he went up to 14,400 feet to obtain close-up photographs of the lofty Fairweather group along the international boundary 125 miles northwest of Juneau. Mt. Fairweather is 15,480 feet, and the adjacent ranges are 8,000 to 14,000. The approach had to be from the southwest. A 60-mile wind was driving from the northwest, resulting in violent down bumps. The plane had been lightened as much as possible but the tip of the peak could not be attained. While trying to get to the westward on the Pacific slope through the pass between Fairweather and Crillion, after two and a half hours' hard climbing, a strong down current forced the plane from 14,400 to 12,500 feet —not more than 200 feet above the sharp ridges. It was a narrow escape but it was all in the day's work. As Chief Photographer P. A. McDonough's camera had been thrown against the side of the cockpit by the harsh jolts and put out of commission, Lieutenant Wyatt then headed for lower country.

Planes Traveled 50,000 Miles

This flight brought out the interesting fact that the Grand Pacific Glacier, which formerly extended well down into American territory, has receded to a point about one mile within Canada, thus giving that dominion a port in southeastern Alaska. Since the headwaters of Icy Straits for a distance of 50 miles are completely covered with a floating ice pack, a polar explorer would be needed to navigate a ship there and this hitherto unknown contact with tidewater may therefore be useless for thousands of years to come.

During the *Gannet's* sojourn near Juneau, her cold-storage plant was supplied with ice cut out of small bergs from Taku Glacier that were corralled as the incoming tide floated them past the ship. The larger bergs constituted a real menace to the planes, which could not be run entirely out of the water because the beach was too small, and a watch was established to ward them off. This was dubbed the "Alaskan Midnight Ice Patrol" and was not popular with the "members." All this ice notwithstanding, southeastern Alaska has a climate about as mild as that of Kentucky, and even in late autumn the gardens of Skagway and Juneau furnished flowers to decorate the *Gannet's* wardroom table.

On Prince of Wales Island, virtually unexplored, a bay was found to be six or eight miles from the location shown on existing charts. This illustrates the need of the survey. Such uncertainty becomes a serious matter in an isolated region where there is so much travel in such very small craft as rowboats. In one day, August 1, almost 1,000 square miles of this island was completely mapped.



HEAD OF BAIRD GLACIER

This interesting photograph shows how the ice flow is forced between its banks and formed the same as any river

Only amphibian planes could be operated in Alaska. Land planes would be useless because there are no landing fields, and sea planes would be unsuitable owing to difficulty of anchoring in the extreme depth of all the inland waters and the severe wind and rainstorms prevalent there. The Loenings are the same type as that used by Commander Byrd, U. S. N., on the McMillan Polar Expedition, with inverted Liberty motor, 450 horsepower at 118 miles an hour, and cruising radius of 700 miles. Two were employed in mapping and the third for radio and standby, being kept in full readiness for flight. Upon their return to San Diego they had covered an aggregate distance of fully 50,000 miles, equivalent to twice around the globe. In mapping, each carried a pilot, navigator and photographer. Emergency rations and service revolvers were always taken against emergencies.

The expedition was in constant communication with the Commander of Aircraft Squadrons, Battle Fleet, San Diego, by high-frequency radio, and similarly in touch with most of the world.

JUNEAU FROM THE AIR

How the capital city of Alaska appears from a mile in the air. The capitol building is in center foreground and the high school building directly behind it

FLOATING ICE IN MIDSUMMER

LeConte Bay, dotted with many floes of ice, makes a picture that defies description. Notice in particular the vast forests covering the sides of the mountains

By permission of the Royal Anthropological Institute of Great Britain and Ireland

FLINT AS IT OCCURS IN CHALK BEDS AT EAST RUNTON, NORFOLK, ENGLAND

FIGURE 1: *A line of flint extends across the face of the cliff, just above the cross. Flint is formed from silica deposited from suspension in chalk seas*

Flint—Prehistoric Man's Steel

Our Ancient Ancestors Were Just as Keen About the Quality of Flint as We Are About the Quality of Steel. They Even Imported It From Long Distances

By J. Reid Moir

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AN ever increasing number of people are becoming interested in the question of the great antiquity of man upon this earth. In various parts of the world, trained archeologists are at work tracing the history of the human race back to its earliest beginnings, and from time to time the public hears of epoch-making discoveries resulting from these widespread researches. Although, occasionally, by great good fortune, the actual bones of ancient man are unearthed, yet the overwhelming mass of evidence of his existence at remote periods, takes the form of implements and weapons made of stone.

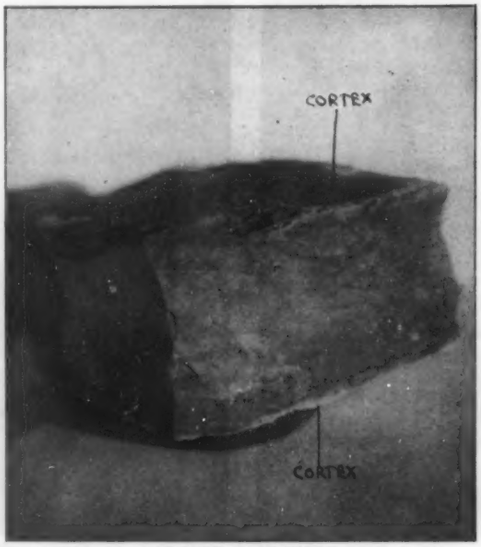
Whence Comes Flint?

In Western Europe, where by far the greater proportion of traces of early man have been found up to the present, the chief material used in making prehistoric artifacts was flint, and it seems necessary, therefore, that some account should be given of the mode of occurrence and the nature of this rock, in order that those who are interested may be able to form an idea of the material so largely used in ancient times, and the flaked examples of which provide the chief evidence in favor of a belief in the great antiquity of the human race.

There are few people who are not familiar with the appearance of flint or chert. From our earliest days most of us have been acquainted with the smooth, rounded pebbles which form such a large part of many shingle beaches. Also, we have seen quantities of flint in gravel or chert pits, and one is often asked where all these stones come from.

To answer this question it is necessary to visit a place where a deposit known as "the white chalk" is exposed. The chalk which can be seen in many large pits, railway cuttings, and in the sea cliffs of Southeastern England and other parts of the world, forms the uppermost part of the rocks laid down during the great secondary period (Mesozoic Era) of the earth's history.

The deposits which go to make up this planet have been divided by geologists into four eras, according to their age. These are known as Primary (pre-Mesozoic), Secondary (Mesozoic), Tertiary and Quarternary—or first, second, third and fourth.



TABULAR FLINT

FIGURE 2: *The origin of this form, mentioned in the text, has not been satisfactorily explained*

The maximum thickness of the English chalk is about 1,200 feet, and as it is composed chiefly of the remains of minute creatures that lived in an ancient sea, which, when they died, sank to the bottom of the water, some idea can be formed of the length of time required for the laying down of this material.

The chalk sea which once covered so extensive an area of the earth's surface was evidently rich in silica held in suspension in the water, and this silica, becoming deposited around certain objects such as sponges, shell-fish and other things lying on the sea floor, gave rise to the well-known nodules of flint. Even today sea water contains a certain and variable amount of silica, and it is on record that at certain places the wooden struts of piers and other structures have become more or less silicified in recent years.

Mysterious Rings of Flint

It is clear, then, that the chalk is the original home of the flints. When this deposit was broken up by various natural forces such as rain, rivers, the sea, frost and heat, the contained stones were swept away and incorporated with the newer deposits in which we now find them.

Although it is true that the great majority of flints are derived from the chalk, yet similar silicious concretions occur in deposits of a like nature of many geological ages. Thus, flints are found in the very ancient Carboniferous and lower Silurian limestones, but these form but a small part of the nodules with which we are dealing.

In many exposures of the chalk, definite lines of flint can be seen extending across the face of the cliff (Figure 1) separated by layers of chalk.

These lines represent the differing levels of the sea floor, but in some chalk pits masses of tabular flint (Figure 2) of wide extent are observable, and these are not so easily explained. It is, in fact, difficult to ascribe the same mode of origin to these as to the ordinary nodular forms. Some have imagined that the tabular flint was produced after the chalk was upheaved above the sea to form a land surface, and this may have been the case, although it is not yet capable of proof.

At various places, such as, for example, the North of Ireland and the county of Norfolk in England, there are found in the chalk extraordinary rings of flint of large size, to which has been given the unusual and not easily explained name of *paramondras* (Figure 3). Some of these to be seen upon the Norfolk coast are three or four feet in height, about two feet in width, and possess a cavity extending from one end of the mass of flint to the other. So far as I know, no explanation of a really satisfactory nature has yet been given of these, but I fear there are many unsolved mysteries connected with the formation of flint.

In this regard it is of interest to note that it is only in the *upper* layers of the chalk formation that flint is found. To explain this one must suppose that it was solely towards the end of the chalk period that the sea became charged with silica, resulting in the formation of the nodular and other masses. But why this should have been the case we have at present no idea.

Arsenic Found in Flint

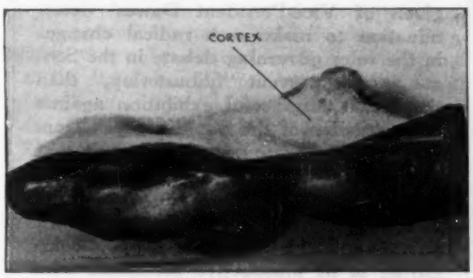
Flint is the fifth hardest substance in nature, and will scratch glass. Most of the nodules when broken exhibit a black interior ringed round with a whitish rind or cortex (Figure 4). But in some areas, as, for example, in Lincolnshire, grey flint occurs and often shows a banded appearance when broken.

The outer crust or cortex of a flint differs greatly from the black or grey interior, both in appearance and in some cases in hardness. Unfortunately, we do not know how this cortex was produced, but some observers have imagined it to be of a similar nature to the so-called "patina" which forms upon the surfaces of fractured flints after long exposure to atmospheric conditions. In the case of the flints found in the chalk, however, no such conditions have been present, and I do not think that the cortex can be explained in this way.

We have no explanation to offer as to why, in the case of any given nodule, the flint-forming process should suddenly cease and the production of cortex take its place. Broadly speaking, flint is composed of an intimate mixture of two kinds of silica, the amorphous and the crystalline, but it contains other and unexpected ingredients as well.

Some little time ago Sir Ray Lankester, the great English scientist, subjected a piece of flint fresh from the chalk, to chemical examination, and found that it contained, of all things, traces of arsenic. Strange though it may seem, some flints, too, possess a distinct odor which can best be likened to that of soot, while many specimens assume strange forms which simulate human legs, arms, feet (Figure 5) and other portions of the body.

In the Sedgwick Museum, at Cambridge, England, there is a collection made by the late Professor McKenney Hughes, which well illustrates these curious and of course perfectly natural concretions. Not only are portions of the human body simulated in the forms of flints, but a number of examples bear a striking resemblance to mammalian bones, and I have frequently had such specimens brought to me for identification.



A FLINT NODULE

FIGURE 4: *It is black, and has a white crust, or cortex. This is the form of flint which ancient man valued most highly as a source of material for making his implements*

The lower Eocene Epoch deposits in Southeastern England rest upon the chalk and contain in the basal layer a large number of green-coated flints which often assume grotesque shapes. In the Thames Valley great areas of the Eocene beds are removed in the exploitation of the underlying chalk, and the workmen having noticed, as they thought, that many of the Eocene flints resembled the heads of bulls, called these specimens "bull's heads,"—a term which has now passed into geological nomenclature, as the lower Eocene deposit is generally spoken of as the "Bull-head Bed."

As has been stated, flint was the chief material from which prehistoric man made his implements and weapons, and it was owing to the comparative ease with which this rock fractures in a conchoidal manner that he was able to do so with success. There is no doubt that these ancient people were highly proficient flakers, and probably knew more about the vagaries of flint fracture than anyone living at the present day. Flint to them must have been as important and necessary as coal and iron are to us, and we know that our early ancestors went to extraordinary trouble to provide themselves with the best kind of flint, as is proved by the prehistoric pits sunk into the chalk at Grime's Graves in Northwest Suffolk and at other places in England and on the continent of Europe.

At Grime's Graves the ancient workings cover about twenty acres and over this large area pits averaging thirty feet deep and the same in width at the mouth, were dug in order to exploit a vein of first-class flint found in the chalk. In sinking these shafts the miners passed through and apparently discarded those layers of flint which they evidently did not consider good enough for their purpose, but when the desired material was reached the whole of it was removed from the space uncovered at the base of the pit and the vein was followed up by driving lateral galleries in all directions.

When it is realized that all this work was accomplished by means of deer's antlers as picks and flat bones as shovels, some realization is possible of the difficulty and the magnitude of the work undertaken.

These people were evidently experienced miners, for an examination of the shafts demonstrates that when digging down through the sandy strata overlying the chalk, which strata might be likely to cave in, the sides of the pit were formed on the slope, while when the hard resistant chalk was reached the sides became nearly vertical.

The pits are roughly circular in form and the excavations of two of them, carried out by the Prehistoric Society of East Anglia, have revealed an astonishing number of the flint implements and other relics of these ancient miners.

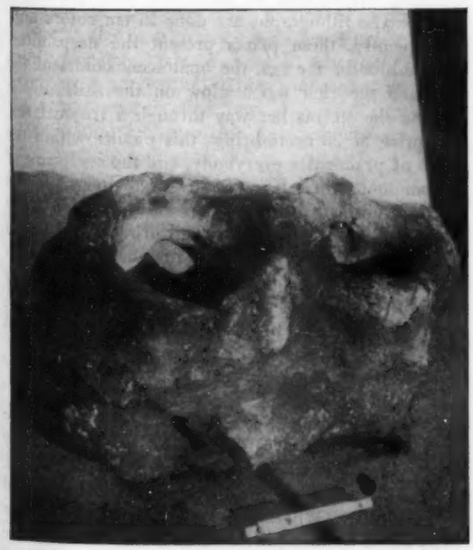
Flint Used in Ancient Trade

At Prosigny-le-Grand, in France, a remarkable stratum of flint of a peculiar honey color was exploited in prehistoric times for the manufacture of flint implements. From the fact of specimens made from Prosigny flint having been found at places far removed from the source of origin, it is inferred with great probability that a trade in these artifacts was being carried on, and it is possible that Grime's Graves and other places were also great trading centers of flint implements.

It is probable that from the very earliest times certain areas where good flint was obtainable were known and visited by ancient man, and this, indeed, seems to have been the case even so far back as Cromer Forest Bed days, when Chellean man, living in the old valley of the Rhine, extensively used the flint of first-class quality, exposed along the flanks of that valley in what is now the county of Norfolk.

It is somewhat difficult to imagine how the progress of man could have been achieved if he had not had such a remarkably suitable material as flint from which to make his implements and weapons, and a knowledge of the mode of origin, and manner of fracture of this rock is of fundamental importance to all those who make a study of man's antiquity on this earth.

¶ In a future issue Mr. Moir, himself an expert flint worker, will describe the mechanical principles which govern the making of flint instruments.



A PARAMONDRA

FIGURE 3: *Rings of flint such as this one, (which is double, having two holes) are called paramondras. Their origin is unknown, although many conjectures have been made*

A FREAK FLINT

FIGURE 5: *It resembles a human foot but this is a coincidence, since the forms that are found resemble not only parts of the human body, but many other objects as well*

Our Point of View

Europe's Largest Hydro-Electric Dam

AMERICANS are more or less familiar with the name of Colonel Hugh L. Cooper, the designer and successful builder of the great Keokuk Dam across the Mississippi, and one of the most active engineers in connection with the Muscle Shoals Dam and other hydro-electric plants of magnitude in the United States. This same Mr. Cooper has been retained by the Russian Government as Chief Consulting Engineer of a great super-power project on the Dnieper River in the Ukrainian Republic. He tells us that the works will be built and financed by the Soviet Government; will cost about 70,000,000 dollars; and will take about six years to build. Eventually, the total installation will consist of a thoroughly modern hydro-electric plant of 650,000 horsepower.

The dam across the great Dnieper River will be 120 feet high and shipping will pass the obstruction by a series of three locks. When the works are completed, they will render the Dnieper River navigable from the Black Sea for a distance of about 600 miles through the extensive coal, iron and wheat belt of the Ukraine. The hydro-electric energy will be developed for the Russians at a cost that will be well below the average cost of such energy in the United States. There will be a similar economy in the cost of transportation for imports and exports through Kherson and east of Odessa.

The World War proved, among other things, how far Russia was lagging behind the other European nations in industrial development. It was this backwardness that beat her in the great conflict. Nothing of a material character will prove of greater benefit to that vast country than the cheap power and the ease and low cost of water transportation which will be made possible in the far-flung Ukraine district by the construction of this dam across the Dnieper River. It will serve as a powerful lever to promote and maintain a large industrial growth and so assist in bringing forward the day when the cost of manufactured products in Russia can be materially reduced.

The engineering and industrial development of Russia is in its very infancy, and because of certain general similarities in the territory of the two countries, particularly as regards their vast extent and the great size of the river systems, it is probable that the securing of this great contract will prove to be a notable step in an extended introduction of American engineering methods.

A Call for Reforestation

IF the American naval-stores industry, producing resins, tar, turpentine, et cetera, is to maintain its present standing, we must adopt scientific measures of conservation and reforestation in the pine-growing sections of this country. The Department of Commerce warns us that the naval-stores industry realizes that it is facing a problem upon the solution of which depends its continued existence. The matter is so serious that it has led, recently, to the formation of the Pine Institute of America, which is made up of the producers of lumber and naval stores and of the distributors and consumers of the same. Forestation, of course, is the fundamental object of this movement, and in France we are presented with a very fine example of what can be done in working out a system of forestation in connection with pine-growing lands.

The Government tells us that Georgia and Florida at present produce about 75 percent of the naval stores of the United States. North and South Carolina, which a century ago furnished about 90 percent of the total production, now provide only 2 percent —another notable instance of the fact that Uncle Sam is apparently an incorrigible spendthrift. As long as the far-spreading pine forests of the Carolinas offered an apparently inexhaustible supply, nobody thought or cared about reforestation. This attitude has brought about its invariable result, for there are vast areas of cutover lands in the southern states that are non-productive.

That this subject is one of great importance, not merely to us but to the world at large, will be understood when it is stated that the United States supplies about 60 percent of the world's naval-stores production, while France comes second with 20 percent. The consumption of turpentine has not kept pace with the progress of the paint and varnish industries which are, of course, its chief consumers. In times of high prices, the paint and varnish people have turned to substitutes which frequently have permanently taken the place of turpentine. The cutover lands in the Carolinas above referred to should be made the subject of intelligent and sustained forestation; otherwise, not only will the soil be lost by erosion but a profitable industry will be lost to the south.

Burlesque in the Senate

No stronger endorsement could be given of Vice-President Dawes' determination to make such radical changes in the rules governing debate in the Senate as will prevent "filibustering," than the recent disgraceful exhibition against the discussion of the Boulder Creek Dam Bill. For it was no ordinary measure that was before the Senate. On the contrary, the damming of the Colorado River is the most important public engineering work now before the American people, comparing in its prospective usefulness with the Panama Canal or the proposed St. Lawrence waterway. Boulder Creek Dam is an emergency project, and until it is completed, the wide-spreading and fruitful Imperial Valley will be subject to the threat of such a devastating inundation as that of 20 years ago. There is every reason for the construction of this work and not one can be offered against it.

This bill which is awaiting the approval of the Senate will not only rid the western farmer of a frightful and ever-present menace, but will gradually, as the years go by, place at his disposal hydro-electric energy up to a total of five million horsepower. Five great western states await the decision of the Senate. What does the Senate do? Instead of hastening to obey the will of the people, it turns itself into some sort of serio-comedy vaudeville performance—all for the purpose of satisfying the whims, prejudices and questionable ambitions of a few third-rate politicians.

The Centenary of the Match

PROBABLY the year 1927 will run its course with little, if any, recognition by the great world of the fact that in this year the match—the humble parlor or friction match—reaches its centenary. Trifling and inconspicuous though it may be, the coming of the match was an event of the very greatest importance to mankind. To be convinced of this, think of the descriptions of the trouble our forefathers had in getting a light with the old flint-and-tinder box.

The inventor of matches was a certain John Walker of Stockton-upon-Tees, England. The matches were made by dipping little splints in melted sulphur and then in a liquid composed of potassium chlorate, antimony sulphide and gum water. Walker, who was a chemist, employed the poor of the town to split the wood for these early matches, and although pressed to form a company, he refused on the score that he had enough for his simple wants, and that he would put no obstacle in the way of a thing which promised to be a boon to the public. In the Scientific American of April 20, 1895, the invention of the match is credited to Walker, "who took priority of all, having invented it in 1827, as his day book proved by the sales entered in it."

Subsequently, there was great activity in developing friction matches. Janos Irmzi, a Hungarian, made the same discovery in 1835; Kammerer, the German, discovered it in 1833 and Sauria, the Frenchman, in 1831. The first American patent of the friction match was taken out in 1836.

In Full Sail

NOTHING that the committee which is gathering funds for the rebuilding of "Old Ironsides" has done should prove more effective than the sale of the beautiful prints of the old ship, reproduced from Gordon Grant's painting which is now hung in the White House. Gordon Grant followed the sea himself for some years. He knows ships, and he has placed upon canvas what we consider to be the most perfect picture of a frigate in full sail before a spanking breeze that we have ever been privileged to see. The lithographs are done in ten colors and, consequently, these prints present the deep ultramarine blue of the sea, the opalescent colors of the sky, and the rich warm glow on the sails of the ship as she storms her way through a tropical sea. The price of 25 cents brings this picture within the reach of practically everybody, and the enclosure of this amount with a letter addressed to Rear-Admiral Philip Andrews, United States Navy, Boston Navy Yard, Boston, Massachusetts, will bring you this gem of marine painting within a few days. If properly handled, the sale of these prints should bring in the 200,000 to 300,000 dollars that is still necessary to make up the fund for rebuilding "Old Ironsides."

A Chance to Make Good

Those who have been called "quacks," because they claimed to have a cure for cancer will now have an opportunity to make good on this claim. A 50,000 dollar prize has been offered for a real cancer cure. Whatever else this handsome offer calls forth, it does provide a new way to divide the sheep from the goats: if anyone offers you a "sure cure" for cancer, tell him how easily he can win that 50,000 dollars.

The Hottest Thing on Earth

How Astronomers Imitate Stellar Temperatures of 36,000 Degrees, Fahrenheit

By Henry Norris Russell, Ph.D.
Professor of Astronomy at Princeton University
Research Associate of the Mt. Wilson Observatory of the Carnegie Institution

ONE of the most familiar distinctions between the astronomer and the student of other physical sciences is that he is an observer rather than an experimenter. The physicist or the chemist may bring the thing that he wishes to study into the laboratory, and subject it there to tests as varied as his equipment and his inventiveness permit; but the astronomer cannot shift the stars or planets—no, not so much as a meteor—at his will. He must wait upon Nature, and keep a watchful eye for those experiments which she performs without his advice or consent.

Yet it is not too much to say that an artificial imitation of a star has indeed been produced in the laboratory—and one not merely as hot as the sun, but three times hotter—and this without using any substances of higher melting point than those which are familiar to us all.

"There must be some trick about it," the reader may exclaim. So there is. These experimental stars shine only for a few millionths of a second—they are made by "exploding" fine wires by a powerful electric discharge.

Several investigators have worked in this fashion. The most noteworthy results have been obtained by Anderson at Mount Wilson, and a detailed account of much interest has recently been published by him and his colleague Sinclair Smith.

The wires may be made of any electrical conductor—metal or alloy—that can be drawn or worked sufficiently fine, ordinary fine wires being far too coarse. To explode them they are placed in circuit with a large condenser, which may be charged to a potential as high as 40,000 volts, and can store up energy enough to keep a fifty-watt lamp going for half a minute. Perhaps this does not sound like very much; but, when the circuit is suddenly closed, the stored-up energy rushes back and forth in a current alternating at the rate of some 60,000 times a second, and reaching the enormous maximum value of 30,000 amperes. The oscillations die down rapidly, and in less than a ten-thousandth of a second the disturbance is almost over; but during this brief interval, energy is being dissipated in the form of heat at the rate of more than ten thousand kilowatts. For that time, it is as if the whole power output of a generating station big enough to light a city was concentrated into a wire a couple of inches long and finer than a hair. It is no wonder that something happens!

The thing is striking enough to watch—as the writer has done time and again in Dr. Anderson's laboratory. The fine wire is laid in place, the switch in the circuit is opened widely, and the high-voltage transformer set going. For perhaps a quarter of a minute the charging process goes on, and the hum of the transformer, at first loud, dies down as the condenser becomes loaded up almost to its point of saturation. Then the operator, standing at a safe distance, and by means of a long wooden lever, closes the circuit. There is a blinding flash, a loud report of extraordinary and ear-piercing sharpness, and the wire is gone. Not so much as the finest dust remains.

So much our senses can detect; to find out more, we must supplement them with quicker-acting aids. By photographing the "explosion" reflected on a rapidly revolving mirror it is found that the wire is almost instantaneously converted into a thin filament of incandescent vapor—evidently at high pressure—which expands in all directions until it has swollen to a diameter of an inch or so, and then sunk to atmospheric pressure. This process takes perhaps 1/25,000 of a second. After it is complete the incandescent vapor cools and the light dies away. There is no true explosion in the ordinary sense of the word; the wire is simply heated so rapidly by the enormous current that it bursts into vapor. Calculations based on the known properties of the metal show that an iron wire would melt in about a quarter of one millionth part of a second, begin to boil in twice this time, and be completely evaporated before a millionth of a second had passed. The incandescent vapor would at this moment have a temperature of nearly 3,000 degrees, and would exert a pressure something like half a ton per square inch, so that it flies outward in all directions, faster than the fastest military projectile, driving the air before it so abruptly as to account fully for the sharp, explosive sound of the discharge.

Hotter Than the Sun's Exterior

Such a mass of heated gas is ionized and full of free electrons and charged atoms, hence it conducts the current from the condenser discharge, and thereby becomes still further heated. How hot it gets at the maximum is rather hard to determine—probably the best way to estimate it is by the brightness of the light which it gives out. When the short time of the flash and its great photographic brightness are taken into account, it appears that at its best the "explosion" is far brighter, area for area, than the sun itself. To give out so intense a light, the temperature of the gas must be fully 20,000 degrees, Centigrade (36,000 degrees, Fahrenheit)—as hot as all but a few of the very hottest stars. At this time, when the vapor is still dense and under high pressure, it gives out a continuous spectrum, and an intense bluish-white light—as it ought to do at so high a temperature. This maximum temperature is reached two or three millionths of a second after the discharge starts.

The presence of the continous spectrum is interesting, as such a spectrum is given out only by an *opaque* incandescent mass. The metallic vapor in the explosion is certainly gaseous. Can it be opaque? A direct proof that it is so has been obtained by setting up, near the exploding wire, a spark gap fed by the same discharge, and giving off an intense bright-line spectrum. When this spark is in front of the explosion, these bright lines are strongly visible, showing that the light of the latter is not powerful enough to drown them out. But if the spark is behind, not a trace of the bright lines can be seen—the incandescent vapor is opaque. But how *can* it be?

At a temperature of 20,000 degrees, there can be no possible chance of the presence of solid or liquid particles, to form a fog or cloud. The gas itself must be opaque. At ordinary temperatures, it would certainly be transparent—and also an insulator. But at the very high temperatures it is a good conductor, and good electrical conductors are always opaque. More detailed discussion shows that, in an ionized gas where great numbers of free electrons and charged atoms are present, light would be powerfully absorbed, and this explains the opacity.

As the intensely heated and compressed vapor expands, it gradually approaches more familiar conditions (if we may use the word "gradual" for a process that takes several millionths of a second for completion). It is easy to understand, then, why photographs of the spectrum of the explosion reflected in a rapidly rotating mirror show that, as the gas expands, the continuous spectrum weakens and disappears, while the bright lines due to a rarefied incandescent gas come out. This happens while the temperature is still very high—as much as 8,000 degrees, Centigrade (14,432 degrees, Fahrenheit), in some cases.

Now all this has striking parallels among the stars. The visible, spotted surface of the sun—the photosphere—which looks with the telescope like a solid layer with sharp, dark markings on it, cannot really be solid, or even cloudy. It, too, is far too hot for the presence of even the slightest condensation. It has been told years ago in these columns how this puzzle has been solved by the realization that the solar gases are ionized, and therefore opaque in layers of sufficient thickness. Above the photosphere, and where the pressure is very low, lies the reversing layer, composed of almost transparent gases, which absorb the dark lines of the solar spectrum.

If, now, in the laboratory, we place our exploding wire in a slot cut in a block of wood, thus preventing too rapid an expansion of the incandescent vapor, the continuous spectrum is much strengthened, and is found to be crossed by a multitude of absorption lines. With iron wire, for example, the whole spectrum of iron in every one of its details, is exhibited in sharp, clearly marked dark lines on a bright ground.

Here we have indeed a miniature sun. The intensely heated, ionized gas at the core of the explosion represents the photosphere, and shines in the same way, and even more brilliantly. The cooler and more rarefied outer vapors form a reversing layer, absorbing light, and giving the dark-line spectrum.

The open-air explosions, with their rapid change from a continuous to a bright-line spectrum, do not resemble the sun at all, but we can find what looks like a close parallel to them among the temporary stars—the novae. The existing evidence strongly supports the belief that these bright outbursts originate in the intense heating of the surface of a star by some unknown process. The incandescent gases expand furiously in all directions. At first they give a continuous spectrum, and as the star's disk expands it increases enormously in brightness. Then as the expanding shell of gas becomes more rarefied the spectrum changes almost abruptly to one composed of bright lines and the light of the star gradually falls off.

This is really strikingly similar to the history of the exploding wire, and the maximum temperatures which are attained in the two cases appear to be roughly the same. It might almost be said that we have produced a temporary star in the laboratory—the principal difference being that our artificial novae are ten thousand billion times smaller, and run their course ten thousand billion times faster than the real ones.

Considering the relative scales upon which Nature and man work, this may well content us.

"THEY WOULD TEMPT A CIGAR STORE INDIAN TO FALL INTO STEP"—THE FAMOUS DEAF BAND

Every one of these musicians has suffered a loss of hearing, the average being 49 percent. Although some can scarcely hear anything, they all thoroughly enjoy the rhythm and tactual feeling of their band music. The only criticism of their music is that they can scarcely be restrained from playing it just as loud as possible

Teaching Music to the Deaf

Even Though They May be Unable to Hear a Sound, the Pupils at a Famous New York Institution for the Deaf Soon Become Proficient with Band Instruments

By John Redfield

Former Lecturer in Physics of Music, Columbia University

IF you were deaf, "deaf as a post," would you want to study music? And, if you should do so, would the study of it have any value for you? You probably think not; but, if so, you are mistaken on both counts.

If you are on the sunny side of 20, playing in a band would afford you greater pleasure than anything else you could do. Such, at least, is the experience of students in the New York Institution for the Deaf, in New York City. Your misapprehension arises from a lack of understanding of what deafness really is.

Most deaf persons, even those "totally deaf," can hear, although not very much. There are a few, it is true, who can not hear at all. But their number is small, and even these can receive sense impressions from sounds, although not through the sense of hearing. With their fingers on the piano, for example, they can, through the sense of touch, feel the piano vibrating. Or they can feel against their skin the atmospheric pulsations caused by the beating of a bass drum, just as you have, through your feet, felt the ground trembling when a train passed.

But this is an entirely different sensation than that of hearing, and should not be called hearing. Persons whose sense of hearing is entirely gone do not *hear* the piano through their fingers, careless statements to the contrary notwithstanding. They merely feel it tactually.

Most persons called "totally deaf" are not entirely without the sense of hearing. They simply do not hear very much. And these can receive sense impressions from sounds both through the sense of touch and, to a slight degree, through actual hearing. They may hear so badly that they have never heard either their own voice or the voice of anyone else, but they might still be able to hear faintly a very loud sound such as thunder, the firing of a near-by gun, or perhaps even the playing of a band very close at hand.

Educating the deaf involves two processes that are unnecessary with other people: their hearing must be improved as much as possible, and they must be taught the things they have failed to learn through lack of hearing, the most important of which is speech.

Most of the processes involved in speech occur behind the lips. The totally deaf miss all this. What the lips do they can see, and by close attention they quite readily become astonishingly proficient in lip reading. But what happens behind the lips they entirely miss, being unable either to see or hear it. As a result, the soft palate, the tongue, and the throat muscles become stiff and awkward from disuse, just as the fingers of an adult who at mature age first attempts to play the piano are found to be "all thumbs."

No One Is Really "Mute"

The first step in teaching the deaf to speak is that of limbering up the muscles involved in speech and getting voluntary control of them. It must be remembered that the person who has never attempted to speak has made little voluntary use, for example, of the muscles employed in breathing. These muscles have pulled pure air into the lungs and pushed the impure air out, but always involuntarily, doing their work just as well asleep as awake. When they are called upon for voluntary action, as in speech, they act sluggishly. Deaf children are therefore given exercises in quick and slow breathing, and in "packing" the lungs—short, repeated inhalations without exhalation until the lungs are "packed."

The uvula, too, needs attention. All a deaf person's life the uvula, that little point of flesh which you can see in a mirror, hanging far back of the roof of the mouth, has hung low behind the mouth cavity instead of being drawn up to let the sound out as with a person of normal hearing. To remedy this, yawning exercises are given; and one authority states that "the value of this exercise can not be overrated." Until the uvula has been raised to a position approximately normal, the vocal efforts are obscure, guttural and unpleasant.

The tongue is a still more unruly member for the deaf than for the hearing person. One would think that the use of the tongue for mastication would have taught voluntary control of it. But such seems not to be the case. Some deaf children appear to have very little control of their tongues. To acquire it, exercises are given in tongue gymnastics: extending the tongue out and up as far as possible, extending it out and down as far as possible, touching the corners of the mouth rapidly, rolling the tip of the tongue around the lips of the widely opened mouth, and grooving and extending the tongue.

Finally, the vocal cords are brought into use for the production of vowel and consonant sounds and their combination into words. Of course the niceties of inflection and the rhythm of speech are almost impossible for a totally deaf person to attain.

These details about the teaching of speech have been given to produce a realization of the fact that a lack of hearing implies a lack of speech—that speech is a function of hearing. Logically, perhaps the methods of improving the hearing should have been presented as a preparation for the methods by which speech is taught. But, undoubtedly, the steps for the improvement of hearing will be the more highly appreciated if it is understood that better hearing is not only an end in itself but a means also toward the acquisition of speech.

It must be kept in mind again that, while there are some persons entirely without any sense of hearing, most persons spoken of as "totally deaf" are merely *very* deaf, and can hear *some* if the sound be sufficiently loud. There are usually some remnants of hearing still left, and upon these remnants educators of the deaf base their aural instruction. And it is at just this point that music, especially band music, fits into the education of the deaf.

It does not require a very great stretch of the imagination to understand that, if you were very deaf, hearing would be precisely one of the most delightful of experiences. And music, if it is sufficiently loud—as loud, say, as band music—can be heard more or less by most deaf persons. And even those without a remnant of hearing can feel loud sound pulsations tactually, although they do not hear them. If you have been near a sixteen-inch gun at the moment of firing, you may have felt the beating of the air against your body. In like manner, if you are quite near a bass drum that is being beaten very loudly, you may feel the air faintly pulsing against your skin in time with the beating of the drum.

The deaf, lacking hearing, depend more than other people upon their other senses, which become correspondingly more acute, and they are thus able to receive tactual impressions from much fainter sound pulsations than can persons of normal hearing. Of all band instruments it is the pulsations of the drums, especially of the bass drum, which are most distinctly felt by the very deaf and that they most enjoy playing. However, a person entirely without hearing thoroughly enjoys playing not only the drums but the tuba or a tenor or alto horn.

They All Want to Drum

In teaching music to the deaf it is with the drums that the instruction begins. Of the 233 boys in the New York Institution for the Deaf, 233 of them would be in the drum corps if the matter were left to themselves—and I suspect the 136 girls would be glad to join them. The teachers of these boys and girls report that it is difficult to keep them from drumming, anywhere, at any time, with anything they can get their hands on—sticks, knives and forks, pencils, fingers, or what not. They enjoy the rhythm tactually even though they may not be able to hear it.

After they have gained some proficiency on drums and have thereby developed their sense of rhythm, the more expert are transferred to bugles, forming a drum and bugle corps. Such buglers as are entirely without hearing must learn to produce the four notes of the bugle scale, g, c, e and g, wholly through the muscular sense of tension of the lips without any recourse to the sense of hearing. Mr. Isaac Gardner, principal of the Institution, states that a boy totally deaf can learn to play the bugle "acceptably." One can imagine he might not be able to give an artistic rendition on a state occasion to such a masterpiece of sublime simplicity as "Taps." The surprising thing is that they learn to play well enough for ordinary field work—which they do.

Proficiency having been attained on the bugle, the more skillful are shifted to the valve instruments. The only new thing to be learned is the fingering, and this is a simple matter. The most skillful players of all are put on the melody instruments—the cornets and trombones. Valve trombones are used almost exclusively, although at present they have one slide trombone played by a boy whose hearing is distinctly above that of the others. Clarinets, according to their band instructor, are difficult for them to play in tune and are suitable only to players with fairly good hearing.

The degree of skill attainable on the melody instruments depends almost entirely upon the amount of hearing still remaining. The solo cornet player of the present band has, on the left side of his head, no opening whatever from the outside air to the middle or inner ear. But his right ear tests 60 percent good on the audiometer. The writer's ears tested 95 percent for the left ear and 85 percent for the right. An average of 75 percent for both ears is considered necessary to follow an ordinary conversation without lip reading. The average hearing of the whole band for both ears is 49 percent.

Pitch is at first a great mystery to the children. They sometimes get the impression that a musical note means a word, and they often confuse the terms "high" and "low" with the ideas "soft" and "loud." Ask a totally deaf player of the alto horn, for example, to play a sustained open tone *diminuendo* from loud to soft and he is almost certain to drop, in the middle of the sustained tone, to the next lower open tone of the instrument. The explanation of this may, however, lie in his failure to distinguish between a diminution of wind pressure and a decrease of lip tension, rather than from a misunderstanding of the distinction between "soft" and "loud." At any rate, it is a bit beyond them at present to play *piano*.

Of what use is music in the education of the deaf? As yet we have noted only the enjoyment it affords them; and this, it might be contended, is not education. But the pleasure it affords is not all. Every deaf person gets more or less into the habit of not trying to hear; he fails to attend to sounds. This tends to a further deterioration of his hearing. But an enjoyable loud sound, such as band music, furnishes him something he can hear more or less, and worth striving to get. He therefore attends to these sounds, and his hearing gradually improves.

A person may be equally deaf throughout his range of hearing, or he may have "islands of hearing," that is, there may be points in the musical scale where he hears fairly well, and other points where he hears very badly. Mr. Gardner states that their many years' experience in the use of music for the education of the deaf establishes the fact that it improves the hearing of those who are deaf over the entire range, and extends the "islands of hearing" for those whose deafness is of that variety.

How well do the boys play? There is but one legitimate criticism to be made against them. It is nearly impossible for them to refrain from playing very loud! In this way only can they hear the music. And he would be an ungracious critic indeed who would cavil at this under the circumstances. But they certainly do raise the roof. Their horns are battered and antiquated and of the cheapest, yellowest brass, but they play their marches with a snap that would tempt a cigar-store Indian to fall into step. And they seem never able to get enough of their playing.

Started With Military Training

I am inclined to think they could learn to play the drums as well as anyone. They could probably do equally well on other percussive instruments of definite intonation such as the xylophone, the marimba and the orchestral bells. And I should hesitate to prophesy the limit of their possibilities on the piano, especially if they were equipped with ear tubes connected with a microphone attached to the piano sounding board. It would be very interesting to see just how far they could go in a musical way if they were equipped with plenty of really good instruments—drums, bugles, brass, xylophones and pianos.

The introduction of music into the Institution was more or less by accident. More than 20 years ago military training was introduced as a means of improving the carriage of the body and of remedying the shuffling of the feet by those who are totally deaf—they like the feel of it and do not hear the objectionable sound it produces. The value of military training is evidenced by the fact that it has never been discontinued, and by the battalion's record of winning every competition it has entered. Some time after the establishment of military training, a reviewing officer remarked during one of the reviews that "there was something lacking; there really should be some music to make it complete." The suggestion was not lost, and the Institution became the first in the world to utilize music in the education of the deaf, as it had theretofore been the first to employ military training. Both military training and music have since been quite widely adopted for use in similar institutions elsewhere.

TESTING HEARING WITH THE AUDIOMETER

This instrument produces a sound whose loudness can be controlled. A person who can just hear it at its loudest is rated "totally deaf;" at its faintest, "normal"

TEACHING SPEECH WITH THE AUDIOPHONE

As explained at length in the text, in teaching hearing it is first necessary to teach the pupil to speak correctly, for speech is actually a function of hearing

Measuring One 100,000,000th of a Second

How a Slender Stream of Rapidly Shifting Electrons Is Being Made to Trace a Complicated Record of a Lightning Stroke

By H. M. Towne

Lightning Arrester Engineering Department, General Electric Company

To provide a better background for this article, some of us may wish to review a few simple facts of physics. If we create a high vacuum in a closed glass tube having an electrode sealed in either end, and connect these electrodes with a source of oscillating electric current, cathode rays will be repelled from one electrode—the cathode. These rays are corpuscular, not a wave motion. They consist of electrons moving in a rapid, steady stream like the stream from a garden hose. Now by proper means these electrons can be swerved sidewise from their normal course, and it is this fact which makes possible the Dufour oscillograph described in the article below. We can swerve this stream of electrons in any desired direction and to the desired extent simply by placing near it either an electrostatic or an electromagnetic field, or both, and controlling the strength of the fields. The control has the advantage of being virtually instantaneous.—*The Editor*.

CONCEPTIONS of time and standards of time vary greatly in different lines of thought. The geologist talks in units of ages. The historian marks off time in terms of years. In modern industry the efficiency expert deals with what can be accomplished in hours and minutes. In photography the time periods are seconds and fractions of seconds. Lightning-arrester engineers now discuss time in the "micro-second" (one-millionth of a second).

When one is accustomed to measuring events in minutes or hours, time values of one micro-second are difficult to conceive. A micro-second is about the same part of a second as a minute is of two years. For those who are more familiar with distances, a micro-second is nearly the same part of a second as the distance of one inch is of 16 miles.

An event cannot occur in zero time. Even light, with its velocity of 186,000 miles per second, cannot traverse an inch of space without involving time. Light and electricity produce the most rapid phenomena known to science, and it is obvious that with these, much can happen in inconceivably short periods of time.

The earliest research on the phenomena of lightning can probably be justly credited to Benjamin Franklin, versatile scientist and statesman who, after his famous kite experiment in 1752, expounded the theory that lightning was electricity. Ever since the acceptance of this theory, man's effort has been directed to the problem of protecting life and property against damage by lightning.

Lightning takes an annual toll of human life of between 500 and 700, with twice as many injured, in the United States alone, and causes damage to property totaling millions of dollars. Deaths are largely confined to direct strokes in rural sections, but damage to property is more uniformly distributed and may or may not involve direct hits.

Electrical circuits of all kinds are often subject to destruction or damage, even when the lightning flash itself is several miles away. Practically every kind of electric circuit employed to serve man—telephone, telegraph and electric-light lines, railway signals, factory power circuits, radio transmitters or receivers, fire and police alarm systems, trolley car or electric railway circuits, and the big cross-country transmission lines which bring electric power from the places of natural water power to our populated areas—all are subject to damage or complete failure of operation due to the destructive influence of lightning, even though the lightning does not actually strike the circuits.

This destructive influence of lightning on electric circuits is called an "induced effect," or, more correctly, electrostatic induction. Voltages as high as 2,000,000 have been manifested on electric circuits in the region of passing lightning storms. These voltages occur on the circuits simultaneously with each lightning flash in the vicinity of the circuit.

The ever-increasing tendency of our civilization to rely on these various electric systems as unfailing servants in business, domestic and social life has demanded that increased attention be directed to

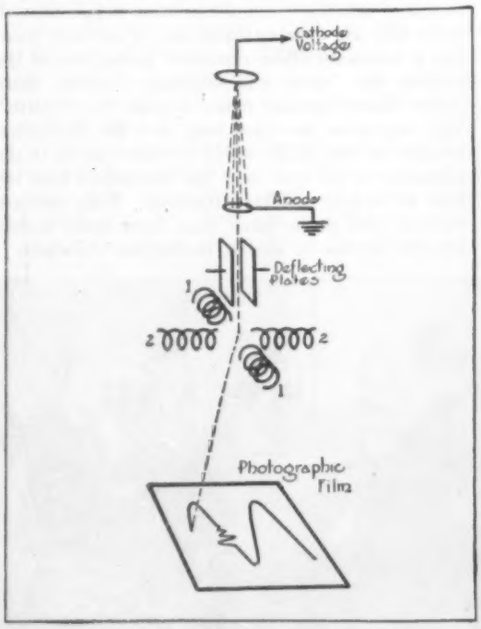
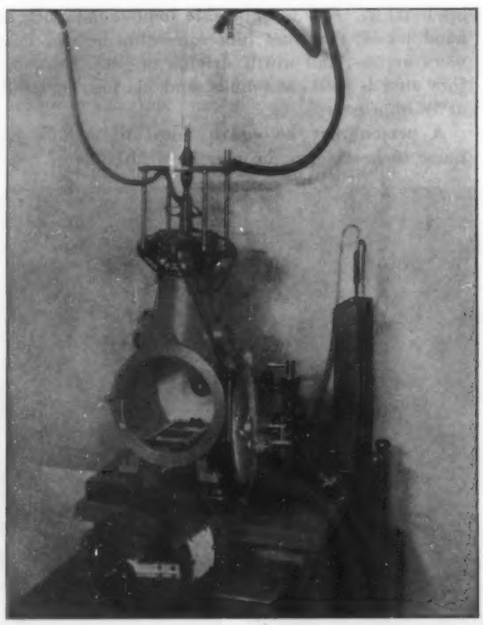


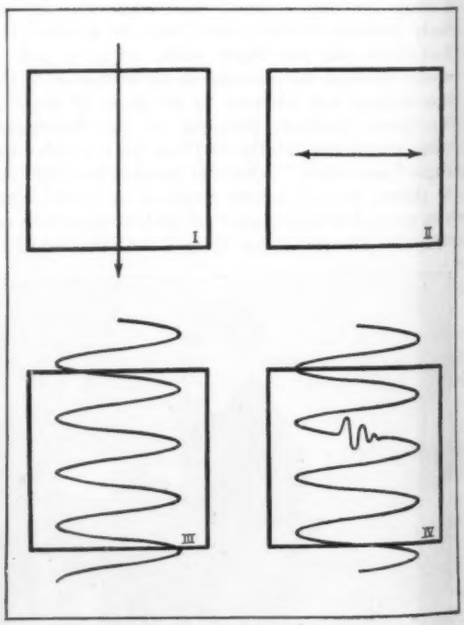
DIAGRAM OF THE OSCILLOGRAPH

FIGURE 2: *The various parts, here schematically indicated, are analogous to those of* FIGURE 1. *The stream of electrons steadily shot downward through the hole in the anode is deflected by the lightning transient, which exerts its force electrostatically through the deflecting plates and electromagnetically through coils 2-2. Coils 1-1 are excited by outside means. Through these quick-moving agencies the lightning actually writes its own signature*



THE APPARATUS THAT DOES IT

FIGURE 1: *This apparatus, described in the text, is not especially complicated. Its operating principle is also decidedly simple, as indicated at the left*



TECHNIQUE OF THE SIGNATURES

FIGURE 3: *The line on the upper, left-hand square is straight because the transient was not oscillatory. That on the second square was not made by a transient, but by the vacuum-tube oscillator, hence it is at right angles to the line in the first square. In the third square is the resultant sinusoidal curve when the first and second are combined; while the fourth is like the third, except that a lightning transient has also been impressed upon it*

EXAMINING OSCILLOGRAPHS

K. B. McEachron of the Lightning Arrester Research Laboratory of the General Electric Company, holding in his hand an oscillogram whose curve shows faintly in the picture

lightning-protective equipment, known to the electrical trade as "lightning arresters" and designed to protect all classes of circuits against damage from abnormal lightning voltages. Lightning arresters form a relief path from the electric circuit to the earth for discharging the dangerous voltages. Thanks to their performance, the various electric circuits are able to operate through violent electric storms without shut-down or interruption and without damage to expensive electrical appliances and apparatus.

It is obvious that the duty cycle of a lightning arrester is extremely important, although short in duration—probably shorter than that of any other equipment. While the arrester is always connected to the circuit and ready to function, the actual period of its performance is limited to the duration of the dangerous excess voltage in the circuit. An arrester may discharge 50 or 100 times during each electric storm, but the time period of current flow through the arrester may aggregate only five ten-thousandths of a second. During an entire year where lightning storms occur very frequently, the total time that the arrester is actually engaged may be less than a minute.

This short duty-cycle does not at all belittle the importance of the arrester, for during each individual period of performance its accomplishment is one of pre-eminence in protecting the much more expensive equipment which constitutes the electric system. A lightning arrester is analogous to the safety-valve on a steam boiler, which may actually discharge perhaps only one minute during several years but by discharging may have prevented an explosion of the boiler.

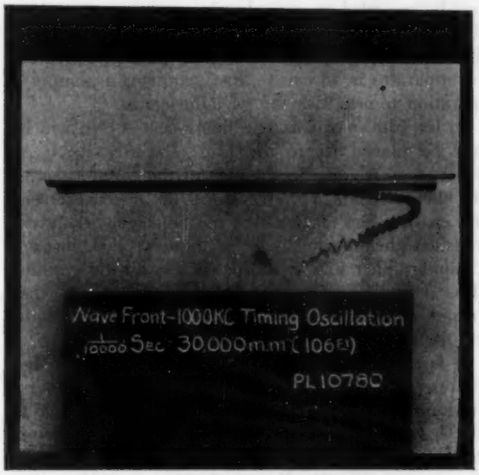
In the study of lightning phenomena and the problem of protecting electrical apparatus from damage, electrical engineers of the past have been limited to a kind of semi-scientific method of attack, because they were forced to rely on observations rather than actual measurements or quantitative analyses. The voltage, current and time duration of lightning phenomena have been subjects of considerable speculation. No indisputable figures have been available.

Artificial lightning generators have been a part of the General Electric lightning-arrester laboratory testing equipment for several years, but no device has been available to give the time duration of artificial lightning, which has therefore been only speculative. The amount of destructive energy released in an artificial lightning stroke, or in a natural lightning stroke, depends upon the *time period* of the stroke. Again, the magnitude of lightning voltage required to destroy any piece of electrical apparatus depends upon the *time period* of the lightning voltage. Finally, the protective ability of any lightning arrester depends upon the *time element* of the lightning voltage and the rate of its application to the arrester.

Time is therefore a conspicuous factor in the fundamental problem of protecting electrical apparatus. Yet, until recently, the actual value of time for lightning transients has been too small for measurement.

Three years ago V. E. Goodwin, engineer on lightning protection, keenly visualized the importance of time analysis of lightning transients, when he harnessed the Dufour cathode-ray oscillograph to lightning research problems. The cathode-ray oscillograph *operates without any mechanical movement*, all the elements being stationary. Even the fastest mechanisms which man could contrive would be far too slow to respond to lightning transients, for mechanisms involve inertia, natural periodicities and harmonics, all of which must be totally absent in the recording of something which happens in a micro-second.

The principle of operation of the oscillograph is the deflection of a cathode ray or stream of electrons (negative particles of electricity) by electromagnetic and electrostatic fields. Figure 1 shows the oscillo-



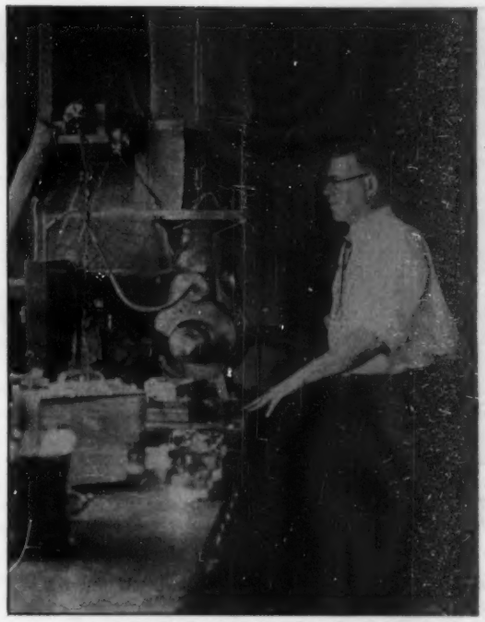
ONE 100,000,000th OF A SECOND!

FIGURE 4: *The entire curve was made in one 500,000th of a second, which is quite a long time when compared with that required to make the little "wiggles" superimposed on it—one 100,000,000th of a second, each*

graph and Figure 2 shows various elements of it. All of the elements except the four electromagnetic coils, 1-1 and 2-2, are enclosed in a vacuum chamber within which the air is exhausted to a low pressure of about five microns (.005 millimeters of mercury). Normal air pressure at sea level is 760 millimeters. Therefore, five one-thousandths of a millimeter pressure in this vacuum chamber represents only 1/150,000 of the normal pressure of the air we breathe.

The deflecting coils 1-1 and 2-2 are mounted on the top of a bronze chamber. A glass tube extends up from this chamber. In it are sealed the deflecting plates, anode and cathode. The coils are spaced 90 degrees apart and are arranged so that they may be rotated about the axis of the glass tube. This permits adjustment of the angle between the axes of the deflecting fields.

When a relatively high voltage is applied to the



OPERATING THE OSCILLOGRAPH

E. J. Wade of the Lightning Arrester Laboratory. This is the same piece of apparatus that is shown in FIGURE 1 *on page 312. The end plate has been replaced for work*

cold cathode, electrons are emitted. Some of these electrons, after being focused through a small hole in the anode, pass down between the deflecting plates and deflecting coils to the photographic film. With no excitation of the deflecting members, the electron stream or cathode ray strikes the center of the film and makes a small spot or dot on it. But excitation of the deflecting members will cause the electron stream to be deflected from the straight downward path and the direction of the deflection will depend upon the axis or direction of the deflecting members. To illustrate: A very brief but uniformly increasing current through the coils 1-1 of Figure 2 would cause the electron stream to be swept across the film at a uniform speed. This is indicated in Part I of Figure 3. With the proper circuit arrangement the stream may be held off the film at the top until ready for the photograph. The one sweep across the film can then be made, and when it is completed the stream can again be held off the film at the bottom.

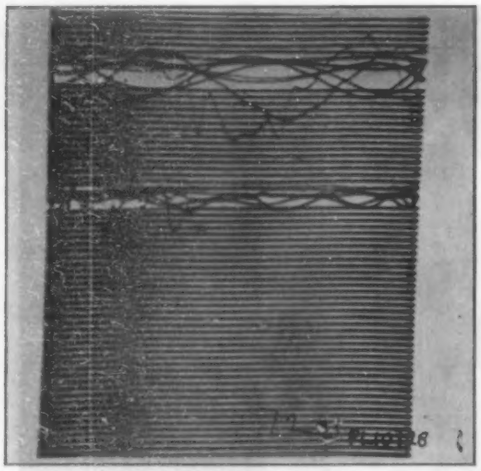
Coils 2-2 of Figure 2 are excited by means of a current from a vacuum-tube oscillator. The frequency can be varied from 10,000 to 1,000,000 cycles per second, and can be measured by a wavemeter. The result is a back-and-forth deflection of the electron stream in a straight line on the film, as shown in Part II of Figure 3, the amplitude usually being adjusted to utilize the entire width of the film. If we now combine the excitation of coils 1-1 and 2-2, we draw out the oscillator frequency-curve shown in Part III of Figure 3.

Thus far this registration has been timing a wave of *known* frequency. But we wish to use it for timing an *unknown* lightning transient.

With the lightning transient properly impressed on the deflecting plates, it will buck or boost the sweeping field, depending on the polarity of the transient. If the transient is oscillatory, it will both buck and boost the sweeping motion. This is illustrated in Part IV of Figure 3, with a slightly oscillatory transient on the timing wave.

Since the frequency of the timing wave is known, it is easy to calibrate the time of the transient.

For example, if the frequency of the oscillator timing wave is 100,000 cycles per second, it follows that the time for the stream to be deflected from one side of the film to the other side would be one-



ANOTHER OSCILLOGRAM

This shows a reflection in a line fifty-six feet in length. The upper irregularity is the impressed transient; the lower one shows the reflection from a short-circuited end

half-cycle or 1/200,000 of a second. If the lightning transient occurs in one-tenth the time of a single side-to-side deflection, then the lightning transient is occurring in one-tenth of 1/200,000 of a second, or one two-millionth of a second—a half of a micro-second. If the deflection of the lightning transient is not sufficiently spread out to be calibrated by the known timing wave, this wave can be increased to, say, a million cycles per second. In this case one side-to-side deflection would occur in one-tenth of the previous time, thus enabling greater accuracy in the calibration of the time element of the transient.

Figure 4 shows the registration of a transient which rose from zero to maximum voltage during about half a cycle of a 1,000-kilocycle (one million cycles per second) wave. Superimposed on this rapidly rising transient voltage one can clearly see many small saw-tooth like oscillations which gradually decay in amplitude. The frequency of these small oscillations is about 100,000,000 cycles a second, and the time between successive "teeth" or crests is one one-hundred millionth of a second!

The amplitude of all deflections may be controlled and calibrated, permitting the accurate measurement of voltage, current and time of a lightning transient.

It is interesting to note that in recording the transient shown in Figure 4, the electron stream was moving on the photographic film at a maximum linear velocity of about 300 miles per second. Much higher-speed transients have been recorded, in which the spot of electrons has been moved on the film at a linear velocity of 12,000 miles per second. This means that the electrons strike a given spot on the film for only two-hundredths of a billionth of a second.

A remarkable thing about the oscillograph is that an ordinary photographic film will respond and retain a permanent record of the path of the electron stream, even at this tremendous velocity and even though the ordinary photographic requirements of a film do not include any attempt to make it sensitive to an electron stream. The recorded path of the electrons on the film can be printed from a negative to a positive print as in the ordinary photographic process.

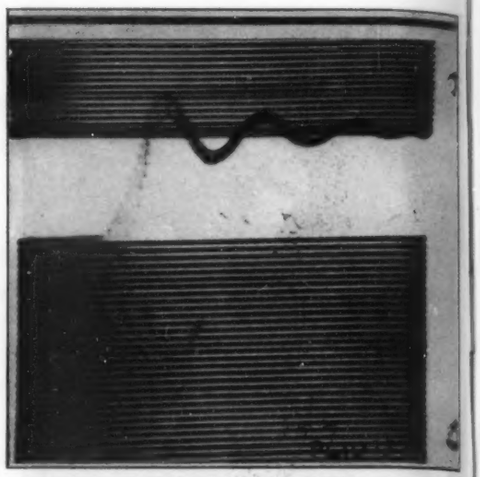
There has been developed a very accurate high-speed synchronous switch which is indispensable in tying together the various operations such as exciting the cathode, exciting the sweeping field and the oscillator field, and applying the transient, all in proper sequence. The importance of this in timing an artificial lightning transient may be appreciated when it is considered that the sweeping motion across the film may be at the rate of half a mile a second, requiring only 150 micro-seconds to cross the film. To get a picture of a transient, it must be applied when the electron stream is still on the film, and with only 150 micro-seconds in which to apply the transient, a high-speed timing switch is the only solution.

The Quickest "Seeing" on Record

Six films may be placed in the magazine at one loading. With some studies, as many as six pictures may be recorded on a single film, making a possible 36 pictures without changing the load of films. When reloading the films, the vacuum maintained in the apparatus is, of course, lost, requiring a pumping operation to establish the vacuum again.

In the film magazine is a fluorescent screen which may be placed where the film normally lies. A small glass window in the side of the bronze chamber then permits a view of the fluorescent screen and enables one to view first on the screen whatever transient phenomenon is to be photographed, just as a photographer first views his subject on the ground glass before putting in films. This allows the proper deflections to be had without any cut-and-try film exposures.

It is an interesting fact that one may look on the fluorescent screen and see transients which were produced in a micro-second or less. The reason for this is that the screen retains the image or path of the electron stream for a much longer period than the stream was actually on the screen. Also, the



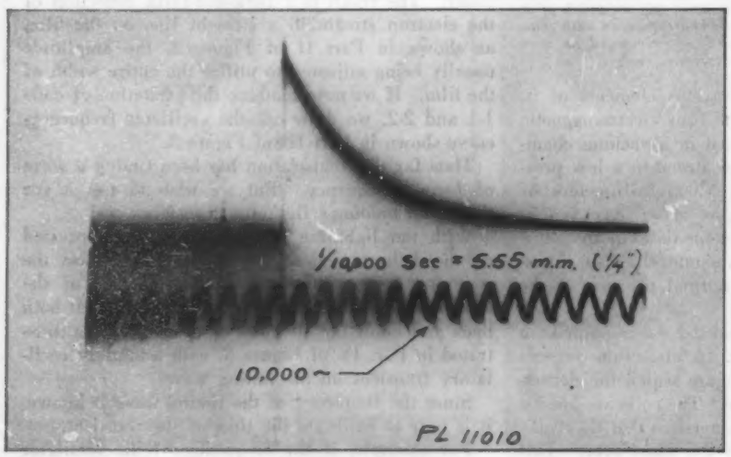
UNUSUAL OSCILLATIONS

This was taken in a lightning-generator circuit whose connections were long. The parallel lines are those of the oscillator before and after the transient was impressed

human eye has a retentivity which tends to make any image last for about one-tenth of a second. For example, it is this retentivity of the eye which makes possible the moving picture in which the exposures may be changing 16 times a second but which to the eye appear to be a continuous picture without interruptions. It is therefore true although amazing that the eye can see a transient which actually occurred in a millionth of a second. In the operation of this device, problems arise which combine physics, chemistry and electricity, requiring an operating personnel of the highest scientific order.

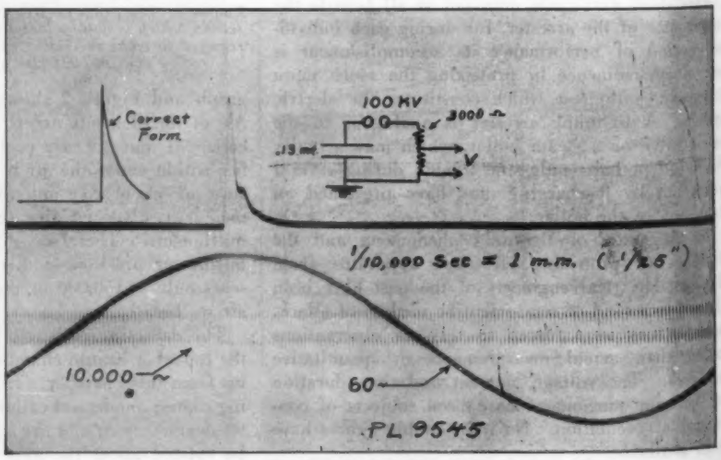
The microscope has proved of inestimable value to science. It enabled man to see and measure what could not previously have been seen or measured. Similarly, the cathode-ray oscillograph equipment at the Pittsfield, Massachusetts, laboratories of the General Electric Company, will unquestionably be a valuable contribution to electrical science. It makes possible the seeing and measuring of what is happening electrically during increments of time heretofore inconceivable. While it is still in the youth of its career, its achievements in lightning-arrester research have already amazed the electrical world.

Until recently, the numbers of sea elephants in the world have been decreasing. But now, as will be told in our next issue, they are being protected and, in Southern California, are once more increasing numerically.



SLOW-SPEED SWEEPING

Contrast this with the one in FIGURE 4; *there the frequency was 10,000 kilocycles, or 10,000,000 times per second; here it is only 10 kilocycles, or 10,000 times per second. When the transient frequency is low, the oscillator frequency is reduced*



TAKEN ON ORDINARY OSCILLOGRAPH

The upper curve shows result of measuring transient current at V in the diagram. Lower curves show 60-cycle wave, such as that of the usual current employed for house lighting, superimposed on a locally generated 10,000-cycle wave

The Month in Medical Science

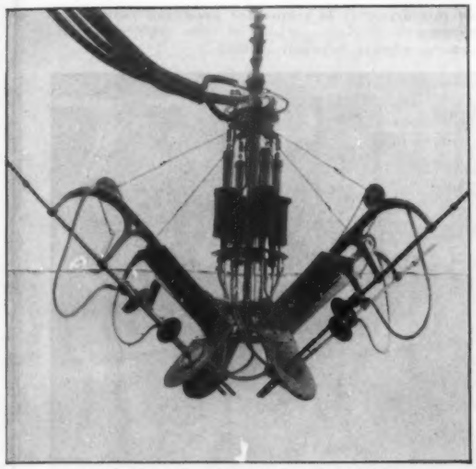
A Review and Commentary on Progress in the Medical and Surgical Field

By Morris Fishbein, M.D.
Editor of the *Journal of the American Medical Association* and of *Hygeia*

New Arc for Ultra-Violet Light

THE importance of providing ultra-violet light for plant and animal life is causing the medical profession to turn its attention more and more to the development of apparatus for supplying such light, particularly since sunlight in most of the area of the United States is not generally available during the greater part of the year, and since its intensity and spectral characteristics undergo constant variations during the day.

As a recognition of the importance of this method of treatment, it may be pointed out that, through



SOURCE OF ULTRA-VIOLET LIGHT

This new arc makes up for lack of sunlight and makes possible treatment at all hours of the day or night and in all locations where current is available

the beneficence of Mr. and Mrs. Charles P. Taft, a special heliotherapy ward has been established in the Cincinnati General Hospital. Dr. R. Plato Schwartz, working in that department, has aided in the development of a new high-intensity arc for providing an equal distribution of radiation perpendicular to the plane in which the patient reclines. As shown in the illustration, this unit consists of four arcs arranged in a circle around a central support and held in lines parallel to those at which the patients are treated. The design provides for the equal distribution of radiation in the treatment circle. The lamp was designed to meet the necessity of treating a large number of patients, each of whom should receive an equal amount of radiant energy per unit of time.

Tuberculosis and Housing

FREQUENTLY the impressions of hundreds of years as to some relationship of general conditions to the onset of disease are confirmed by scientific investigation. Unfortunately this is not always the case. For example, the impression has been prevalent for years that dark, damp, poorly ventilated, or dirty houses were definitely associated with an increase of tuberculosis. Hewsholme, the Minister of Health in Great Britain, showed that the improvement of housing conditions and a decrease of overcrowding in apartments ran parallel in most instances with a decline in tuberculosis.

Now Vladimir Cepulic, Chief of the Tuberculosis Department in the Government Hospital and Tuberculosis Dispensary at Zagreb, in Jugo-Slavia, provides evidence to indicate that the impressions of the past in this matter are incorrect. Cases of tuberculosis did not develop in unclean, dark and overcrowded flats if there were no cases of tuberculous infection in the family. In good homes, in which there was contact with a case of tuberculosis, new cases invariably developed. The source of infection of tuberculosis in other words is a careless person with tuberculosis.

The investigations showed further that the only disinfection necessary after tuberculous persons had moved from a house or apartment was thorough cleaning with soap and water. Indeed, the investigators do not demand the sunlight or airing that are commonly urged in this country. "Flats without sun or light, which are wet, unclean and overcrowded," they say, "and in which one or more phthisical persons or even whole families have lived or died, do not constitute a source of new infections for families moving into these flats after the latter have been cleaned only with soap and water."

In this country, Opie and his colleagues have shown repeatedly that the most dangerous focus of tuberculous infection is a person with tuberculosis who scatters his sputum carelessly about. The housing factor is now rather definitely eliminated.

"We must, once and for all, give up saying that some houses are breeding places of tuberculosis;" says Cepulic, "that tubercle bacilli are flourishing in them; that there are houses which are so much infected that tuberculosis is endemic in them and seeks new victims every day, among both the old inhabitants and the people who have moved into them recently. We must give up believing that dark and unclean flats are a good ground for the existence of tubercle bacilli and that the lack of light is more important for the development of tuberculosis than are overcrowded flats. Briefly, tuberculosis is not linked up with houses or flats; it is linked up with foci of disease."

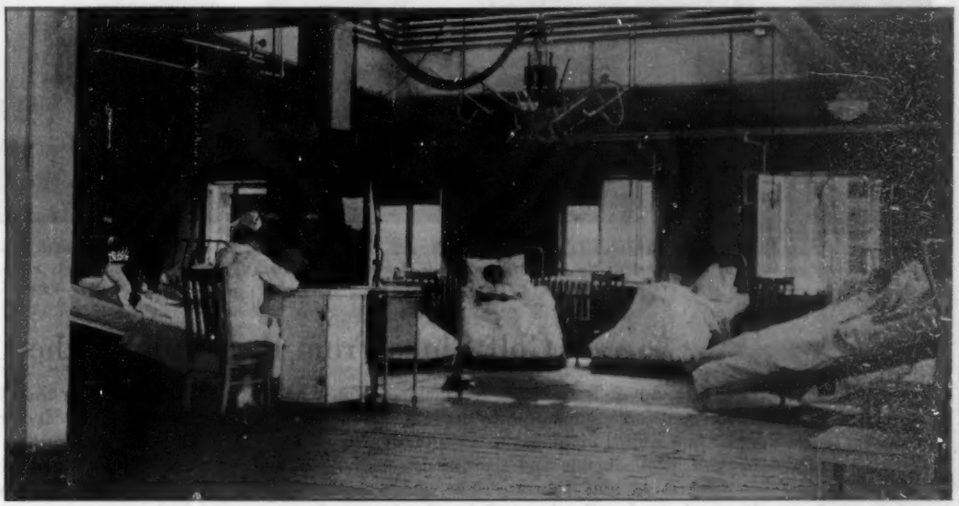
The unemotional scientist takes all of the moralizing attitude out of the preventive medicine idea of the past. He inclines to dispose even of the notion that cleanliness is next to Godliness. He knows but one source of tuberculosis—a flock of living virulent germs, and when these germs are freely scattered about, the disease is not long in following.

Eggs and Milk for Bichloride-of-Mercury Poisoning

FOR many years it has been recognized that persons who have taken bichloride of mercury can be protected to a certain extent if they are promptly given raw eggs, the white of eggs, or milk. These substances combine with the mercury to form salts that delay the absorption of the drug and that hinder the solid tablets from going into solution. They also have the property of coating the walls of the stomach and preventing the absorption of the mercury in that manner. It must be understood that the material must be given at once, since the absorption of any considerable quantity of mercury causes irritation of the kidneys which results in the suppression of its secretions and therefore in death from uremia.

Drs. Torald Sollmann, O. W. Barlow and M. S. Biskind of the Western Reserve University School of Medicine have completed a series of experiments to determine just exactly how these antidotes may best be given. They suggest that the prompt administration of eggs and milk is useful in delaying absorption and in local action, but that in every case the stomach should be washed out repeatedly, the important factor being to get the mercury out of the stomach as soon as possible. It is difficult to completely wash out the stomach if it contains undigested food.

Milk has an advantage over raw eggs in that it spreads more rapidly over the stomach. It is therefore suggested that first a glass or two of milk be administered and then several raw eggs. Egg white does not appear to have any advantage over the whole egg. If bichloride-of-mercury tablets have been swallowed dry, and if milk is not available, the investigators advise the giving of a half glass of water before giving the eggs to prevent the cementing of the tablets by the egg white, and thus making difficult the withdrawal of the mercury.



PATIENTS READY FOR TREATMENT WITH ARC

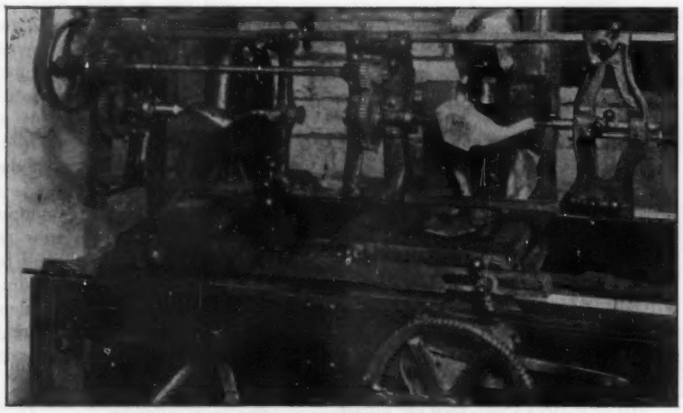
They are arranged in a semi-circle so that each one will receive the full benefit of the rays from the arc light. In this photograph, the patients are ready, with the exception of the removal of the bed clothes. They wear only loin cloths during the actual treatment with the artificial "sun"

SEASONING SHED FOR DRYING THE HICKORY SHAFTS FOR GOLF CLUBS

Several hundred thousand hickory "squares" and dowels are exposed to the air for a period of two years. The object of this drying is to season the wood and reduce the moisture content, so that the right degree of "whip" is attained without brittleness

PERSIMMON BLOCKS FOR CLUB-HEADS

This wood is found best for club-heads on account of the closeness of its grain. These blocks are seasoned for two years



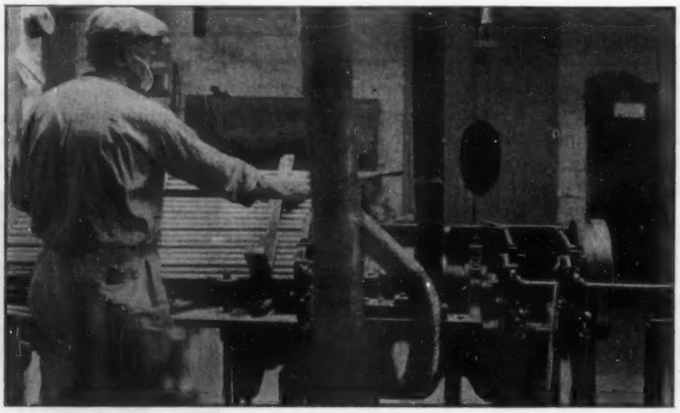
DUPLICATING-LATHE TURNING IRREGULAR FORMS

The metal model on the left revolves synchronously with the wood block, while the rotary cutter is used to fashion the head

All photographs courtesy of the Kroydon Company

MILLING SLOTS IN WOOD HEADS

It is necessary to mill out a channel in the sole of some clubs for a metal plate. This plate prevents wear on the club-head



FORMING MACHINE TAPERS THE SHAFT

Plain hickory dowels are fed in on the left and are turned to the varying tapers required for making well-balanced golf shafts

Golf Clubs From the Forest to the Links

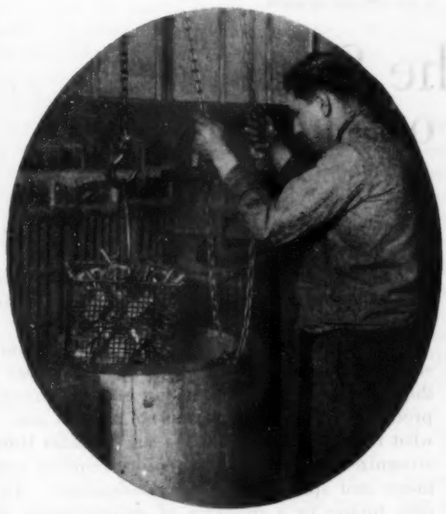
Few people realize the fact, but it is true that the making of golf clubs requires a degree of skill and care comparable to the craftsmanship which goes into the making of fine violins or pianos. Much of the expert hand-work is supplied by golf professionals and their assistants. When the snow flies, they desert northern golf courses, some going south, others opening indoor golf-schools, and still others joining the forces of manufacturers to supplement permanent experts during the busy months. No golf club is better than its shaft, and of first importance is the quality of the hickory used. It is of the utmost consequence that a shaft be neither too springy and "ropey" nor too stiff and brittle. The best second-growth hickory is first chosen in the *standing tree*. After sawing, the wood is selected and re-selected six to eight times. After two years of seasoning, the hickory squares are turned, tapered to the correct form, re-turned and pointed. They are then hand scraped, smoothed, and hand finished. The

FINISHING THE HEAD

This sandpaper cone eliminates roughness and irregularities. The beautiful proportions of the club require accurate finishing

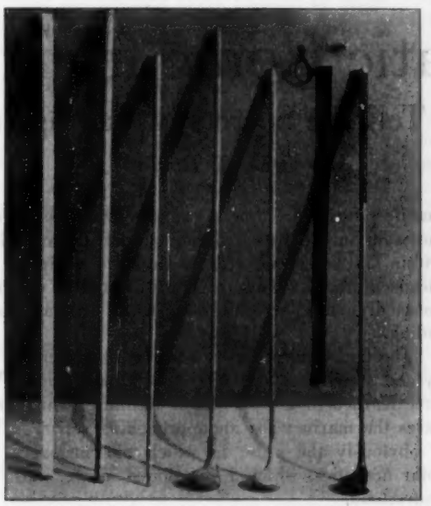
HAND-FINISHING BY EXPERTS

Many professionals and assistants find all-year-around work in the production of golf clubs. Experience has taught them the fine points



HARDENING STEEL HEADS

"Irons" today are made of tempered steel. Lowering a basket into the tempering oil bath

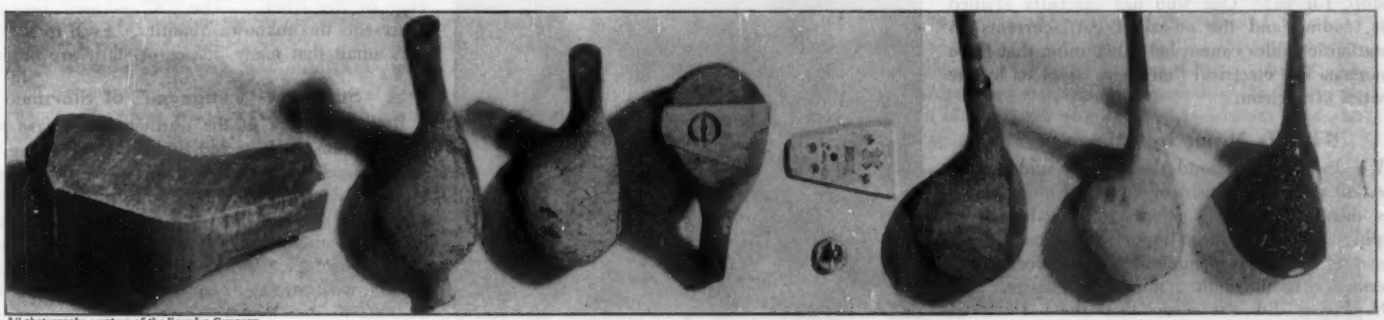


FROM HICKORY SQUARE TO FINISHED CLUB

Steps in making a golf club, showing "square," dowel, formed shaft, head, grip, and whipping

WHIPPING THE LEATHER GRIP

This is a hand operation at which girls become expert. The grip will work loose if not secured

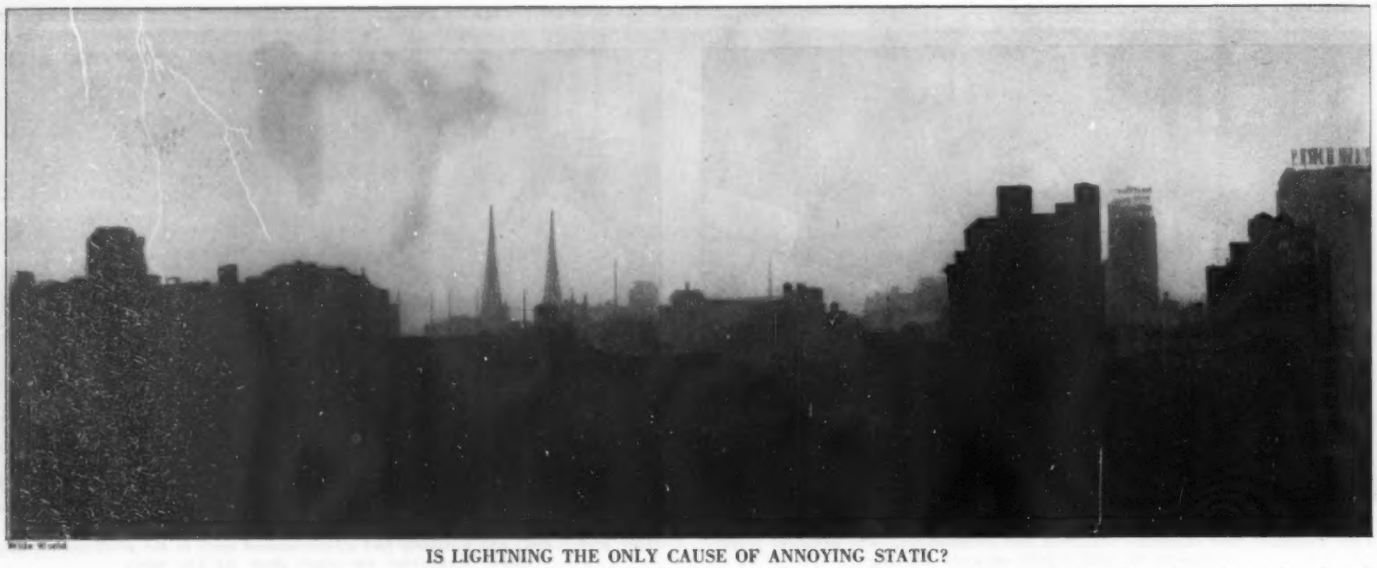


All photographs courtesy of the Kroydon Company

THE EVOLUTION OF A "BRASSIE"

The persimmon block is first turned to shape. Then the false "neck" is cut off, the rough head is smoothed, a slot is milled on the sole, and a metal plate is inserted. The shaft is then secured to the head, the joint is smoothed, and finally the head is lacquered and polished

persimmon blocks for wood club-heads are seasoned for two years; and then turned to the correct shape on a duplicating lathe. The block to be turned is slowly rotated in front of a rapidly revolving cutter. It is moved toward or away from this cutter according to the depth of the cut desired. This movement is governed by a cam, or model, which is an exact duplicate, in metal, of the club-head desired. After turning, the head is accurately bored, a shaft is fitted, and the joint is smoothed on an abrasive cone. A slot is milled in the bottom, and a sole plate attached. The club is then finished, lacquered, and the face is scored. Golf "irons" are made of medium-carbon steel, forged under a drop hammer. They are ground on abrasive wheels, bored for shafts, hardened, and oil tempered. Shafts are then fitted with great care so that the club "hangs" true; and finally the "iron" is hand finished and polished. Every step in this intricate process is checked and verified by frequent tests. Club makers often are seen swinging at an imaginary ball, or eyeing the proportions of a club. When a new model or method is being tested, some lucky man races to the nearby golf course; for testing new products of the factory is one of the joys of the men who make golf their *work* as well as their *play*.



IS LIGHTNING THE ONLY CAUSE OF ANNOYING STATIC?

The consensus of many experts is that lightning storms are not the sole factors in this situation. There is as yet much to be learned about the various phases of static and it is the hope of Professor Michael I. Pupin that the next 25 years will find us nearer to the desired solution

Does Static Come from the Sun?

Strange "Messages" May Tell the Secrets of Fading and Other Radio Mysteries

By Orrin E. Dunlap, Jr.

PROFESSOR MICHAEL I. PUPIN, physicist and inventor, who has been called the "Herdsman Scientist," because he studied the heavens and the twinkle of the stars as a language of space while a shepherd boy in the fields of Serbia, delivered the presidential address at the annual convention of the American Association for the Advancement of Science. The title of his talk was "Fifty Years' Progress in Electric Communication," and in it he mentioned strange solar activities and suggested that static represents "messages" from the sun, 93,000,000 miles away!

After reviewing the triumphs in electrical communication during the last quarter century, Dr. Pupin said, "The question arises, what has the future in store for us? One who has carefully studied static, fading and the so-called earth-currents in transatlantic cables cannot help imagining that these phenomena are electrical "messages" sent us by the activities of our sun.

What Is Meant by "Messages"

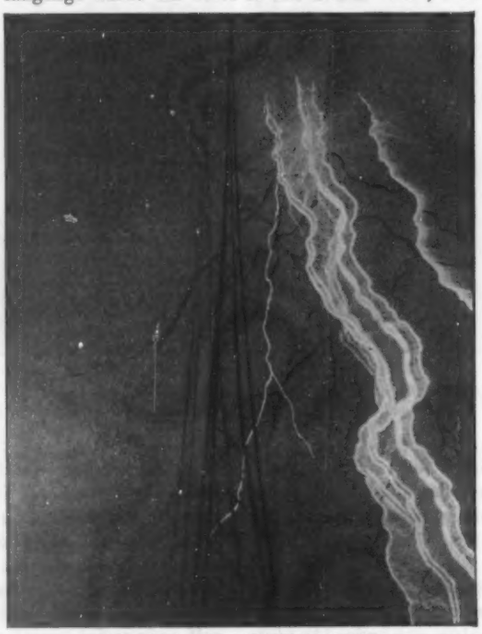
"We do not understand them today and we all hope that the advancement of electrical communications during the next 25 years will enable us to decipher them. The most important advance in the science of electrical communications concerns the transmission of magnetic action at a distance."

Dr. Pupin did not mean that these electrical "messages" could be translated into intelligence as can wireless code signals. He simply used a figure of speech and by expressing the hope that the "messages" might be deciphered, he meant that he was hopeful that man would unravel more of the mystic secrets surrounding static. Thus, in the future, man might control and utilize the atmospheric disturbances instead of allowing them to rumble aimlessly through space as interference to radio.

As Dr. Pupin later explained, "By electrical 'messages' I meant a solar electromagnetic action which manifests itself as static and fading, things that we do not know the cause of today. These manifestations are 'messages' from the sun; not messages in the literal sense, but an action which, within 25 years, we will be able to decipher by means of radio. This deciphering process will undoubtedly show us the real cause of static and fading.

"The barometer records the 'messages' sent to us by the activity of our terrestrial atmosphere. We have learned to decipher their meaning, which prepares the mariner for an approaching storm. This is obviously the sense in which the 'messages' of solar activities, which I mentioned above, must be understood."

The Bible tells that there can be no speech or language where the voice is not heard. This, like Dr. Pupin's reference to messages caused by the sun's activity, is figurative. There is the deaf and dumb language, where no voice is heard. Wireless men talk across world-wide distances with invisible code signals, but hear no spoken words.



STORM STOPS BROADCASTING

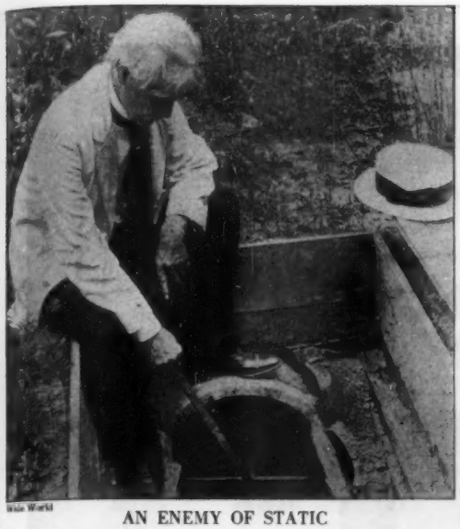
The camera caught this display of lightning at station WJZ The storm was so violent that the station ceased operation

Some believe that static comes direct from the surface of the sun to the earth and others say that the heat and light waves acting on our atmosphere produce an indirect effect and not a direct one. But what is this "language" of the sun? Radio listeners recognize it as clicks, frying noises, grinding sounds, hisses and splashings in the loudspeaker. To the man tuning in a program of entertainment, static means nothing but interference, known variously as atmospherics, strays and "X's." As such it is defined as "natural electromagnetic discharges occurring in the ether." The "X" is used because it represents the unknown quantity. Even today scientists admit that many phases of static are unknown.

Static the "Language" of Storms

Radio auditors in the northern zones are aware that the summer heat and thunderstorms bring more static than the cold air of winter and the longer hours of darkness. There are at least 100 lightning flashes every second, year in and year out, winter and summer, somewhere in the world, according to the meteorological office of the British Government. In fact, it is estimated that Mother Earth experiences 16,000,000 thunderstorms a year, or an average of 44,000 a day, so in any given second there is broadcast from the heavens more electric energy than the world's water-power plants produce in six months.

Is it any wonder that a sensitive radio set, designed to detect extremely feeble currents, will register the clicks of nature's electricity, produced when millions of volts break down the resistance of space as the gigantic bolts leap from cloud to cloud and from the sky to the earth? A powerful electrical disturbance in the south has been known to produce static in the loudspeakers north of the Mason-Dixon Line, and as the storm whirled north, the static intensity increased until the center of the low-pressure area passed. The static then diminished as the



Wide World

AN ENEMY OF STATIC

Dr. J. H. Rogers, who has done considerable experimenting with underground antennas which aid in reducing static

storm moved across the Grand Banks of Newfoundland to waste its strength over the Atlantic. It would seem then that static is as much the "language" of storms as it is the "voice" of the sun.

A study of thunderstorms and static by the British Meteorological Office revealed the fact that electric storms can be detected with modern apparatus up to about 1,500 miles. However, it is not generally believed that lightning is always the source of static.

Dr. L. W. Austin, of the Bureau of Standards and an international authority on static, reports that he has made observations during thunderstorms, which indicated that lightning flashes, even within a radius of three or four miles, were not as powerful in their effects upon the receiver as were disturbances which occurred when no flashes were apparent.

At a London Physical Society symposium, Professor C. R. Wilson discussed the probability of there being discharges from thunderclouds to the upper conducting regions of the atmosphere. His conclusions indicated that thunderheads might readily discharge to a conducting layer, since the electric force required to produce a discharge decreases rapidly with the height. It is believed that discharges of this kind, probably non-luminous, may possibly furnish the explanation of strong static when no lightning flashes are visible.

The French Meteorological Office has published papers in which it is shown that many of the atmospheric disturbances in France are closely allied with the advance of cold-air fronts and that static is accentuated when these air movements make contact with mountain ranges.

On the Atlantic and Pacific seaboards of the United States, except for occasional local thunderstorms, little definite connection has been noticed between the direction of the atmospheric disturbances and rain areas, according to Dr. Austin. On the Atlantic coast the main disturbances seem to come from the southwest, but it is uncertain whether the source is in the Allegheny Mountains, or much further removed, perhaps in Mexico or Yucatan. Experiments made at KDKA and by the United States Navy at New Orleans indicate the more southerly origin.

Observations covering a period of two years, made at Madison, Wisconsin, at the University of Wisconsin, show conditions in the middle west which are similar to those described by Continental European observers; that is, there is no one prevailing direction in which static originates, but a more or less definite relation with thunderstorms and other rain areas. The absence of any prevailing southerly source of atmospherics in the central section of the country casts a shadow of doubt on the Central American origin observed along the Atlantic seaboard, because the distance from Yucatan to Madison, Wisconsin, is not much greater than from Yucatan to Washington.

Position of Sun Affects Static

Dr. Austin has pointed out that on the Pacific coast of the United States it is fairly well established that, at San Francisco and San Diego, the sources of static interference are mostly local, lying in the mountain ranges not far distant. These centers seem to be permanently fixed, resulting in constant directional conditions, according to observations made with loop antennas, which reveal the direction from which radio signals and interference comes.

"It seems pretty well settled in all parts of the world where observations have been made, that there is a very definite connection between the intensity of the static disturbances and the position of the sun," reports Dr. Austin. "In the northern hemisphere, during the winter when the sun is far in the south, the disturbances are generally moderate even as far south as Panama, within nine degrees of the equator. But as the sun comes north in the spring, there is often a rapid and sometimes very sudden increase in static intensity, and it is reported that stations close to the equator experience two disturbance maxima, corresponding to the two periods when the sun is nearly overhead."

European observers have concluded that in only about 35 percent of the cases could thunderstorms be identified as the source of the atmospheric disturbances, but in about 75 percent of the cases the identified sources were rain areas.

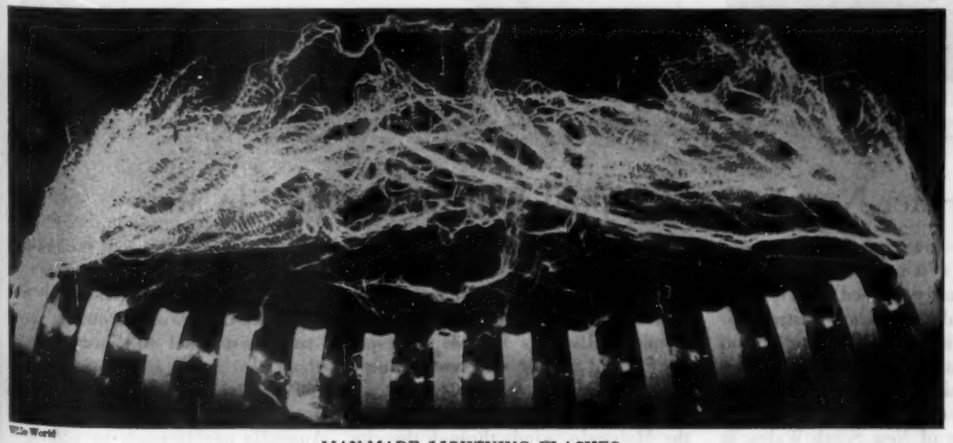
Wide World

TWO ELECTRICAL AND RADIO EXPERTS

Dr. Michael Idvorsky Pupin, right, talking over radio developments with Dr. E. F. W. Alexanderson, television expert

In outlining the present status of static disturbances, Dr. Austin catalogues the facts as follows: (1) In general, atmospherics are stronger at the longer wavelengths. (2) Except for the effects of local storms, static is usually stronger in the afternoon and night, while for the shorter waves this increase in strength is confined usually to the night. (3) Static is stronger in the summer than in the winter; in the south than in the north and on the land than on the sea. (4) A large proportion of the atmospherics appear to be directive; that is, to come from definite regions, or centers, such as mountain ranges, rain areas or thunderstorms. (5) It is also reasonably certain that at least most of the long-wave disturbances travel along the earth with a vertical wave front, like the signals. (6) A considerable portion of the atmospherics is oscillatory in character, although a certain portion is non-oscillatory and gives rise to shock oscillations in the antenna at all wavelengths. (7) Static occurs simultaneously at stations thousands of miles apart.

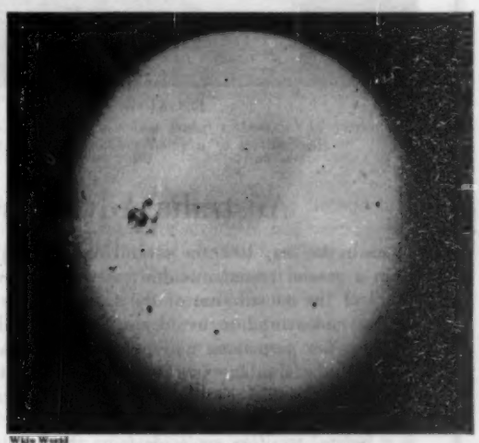
The origin of the ordinary rumbling or "grinder" static is still a subject of many conjectures. Dr. W. H. Eccles of England believed at one time that he had found the source of this type of static, as far as England was concerned, in distant thunderstorms, especially in Western Africa. Others suggest that the "grinders" are caused by the bombardment of the upper atmosphere by electrons from the sun or by charged cosmic dust.



Wide World

MAN-MADE LIGHTNING FLASHES

Is it any wonder that natural bolts of lightning millions of times more powerful than this flash tend to cause static clicks in the loudspeaker, even when the flashes originate more than a thousand miles away?



Wide World

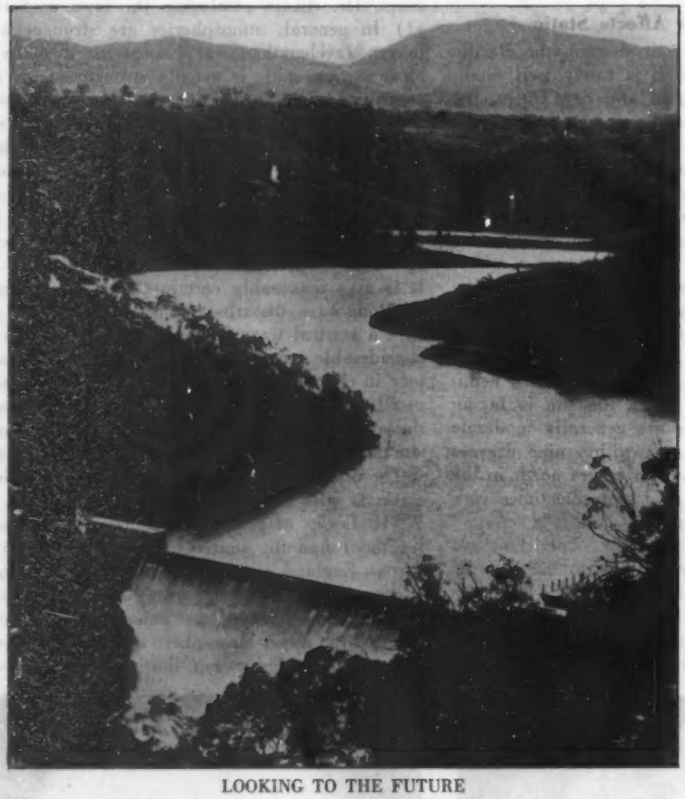
SPOTS ON THE SUN'S FACE

There is a possibility that the magnetic storms that cause these spots are manifest to us by radio static

Air photograph Wide World

WHERE AUSTRALIA'S PARLIAMENT WILL CONVENE

The "temporary" Parliament Building, which will be replaced within 100 years by a finer, permanent structure. Australia is self-ruled by a Senate and House of Representatives, from whose combined membership a Premier, the chief executive of the dominion, is selected. A representative of the British Sovereign is also sent from England



LOOKING TO THE FUTURE

The source of Canberra's future water supply—the Cotter Dam, which impounds the clear waters of a small mountain stream near the capital city

HE DESIGNED AUSTRALIA'S CAPITAL

Mr. W. Burley Griffin, an American architect, who, several years ago, won the competition for a design for the future capital of Australia

Australia Advances—Her New National Capital Will Be Occupied in May

When in the year 1900 the several Australian provinces agreed to unite and form a greater commonwealth government, they first carried out a minute study of the constitution of the United States and patterned closely after it, but endeavored to avoid some of our mistakes. Today Australia is building her permanent national capital and again she has made a careful study of the similar experiences of other nations, especially of our own with regard to the city of Washington. Australia's "Washington" is to be Canberra, until recently an almost empty spot in the mountains. Canberra is a federal territory set aside from the province of New South Wales, in much the same manner as the District of Columbia was made over to the United States Government by two of our states. It contains one thousand square miles and is situated in the southeastern part of the continent of Australia, a land which has almost exactly the same area as the United States. Canberra has been laid out on an undulating plain surrounded by wooded hills. Its latitude corresponds roughly to that of Washington, D. C., and its summer temperature is about the same; its winters, like those of Georgia. The elevation of Canberra, 2,000 feet above the sea, should insure it comparative freedom from sultriness. A small river, the Molonglo, winds through the city. Australia profits much by coming along several generations later in history than the United States. In the

THE FUTURE HOME OF THE BRITISH GOVERNOR-GENERAL

Federal Government House where the Governor-General, representative of the British Sovereign, will live. It was made over from a homestead built in 1921. But few traces of the original house remain. In this house the Duke and Duchess of York will stay while they formally open the first Parliament to sit in Canberra, in May

PROVIDING FOR THE EDUCATION OF THE PUBLIC

The first schoolhouse. The bungalow style of architecture is used very widely in Australia. As Canberra will not have a large population at first, this schoolhouse will suffice. In such matters as the modern planning of public buildings, Australia keeps closely up to date and in touch with the rest of the world. In some ways she leads it

case of Washington, for example, several serious early mistakes were made, although plans to rectify them have now been recorded. It was not fully enough realized here that the capital is the child of the nation and that its upbringing must be fully controlled. In Washington, unbeautiful buildings detract from beautiful avenues; also, the city has grown chiefly in one direction and is topographically unbalanced. The Australian Government, noting these and similar things, has put the federal territory of Canberra in the hands of three Commissioners—an engineer, a surveyor and an expert building contractor. Every private building must pass their approval; also the land is leased, not sold outright. Thus the control is to be closely reserved. Again, in the matter of the various government buildings the Australian politicians have exhibited considerable "headwork." Instead of trying to settle at once on a completed architectural plan for the Parliament Building, a temporary structure has been erected —"temporary" in that it will remain only about one hundred years, a short time in the life span of a nation. It will then be replaced when the Australian people know better what sort of a permanent Parliament Building they want and when they will not have to make any compromises between needs and costs. The temporary building, which is shown at the top of the opposite page, has been placed somewhat in front of the more commanding site reserved for the permanent building, which will be the capitol of a nation of unquestionably large population and wealth. What deserved prescience future generations of Australians will attribute to their forbears! Evidently Australia is beginning right.

Smoke

The World Is Fast Waking Up to the Fact that There Is More of a Menace in Smoke than Has Been Thought. What Shall Be Done About It?

By George T. Moore, Ph.D.
Director, Missouri Botanical Garden, St. Louis

Smoke, city smoke as we moderns know it, is something comparatively new in the world. Ponder the matter: smoke came into man's existence with the great industrial revolution, only five generations ago. We who have created the smoke problem must wrestle with it. Fortunately it is already known that we can whip smoke, if we will, for the chief reason the nuisance continues is *human inertia.* You cannot make much of a dent in human inertia by an emotional appeal, but you can by showing that *smoke costs money.* Twenty years ago a vivid way to dramatize a great industry was to show rows of giant smoke stacks belching forth clouds of smoke. It looked positively thrilling, and enabled one to visualize the throbbing industry in the factories beneath the stacks. But modern industrial experts get no "kick" out of this. To them it means nothing more or less than dollars, dollars, dollars, dissolving into the air, for smoke is mainly a product of incomplete combustion of fuel and these days fuel costs real money. Another generation will pity our age because it tolerated smoke so long, just as our age pities the Dark Ages for tolerating dirt, filth and ignorance. ***The Editor.***

THE problem of how to suppress superfluous smoke is not a new one. Edward I issued a proclamation forbidding the use of coal while Parliament was in session, believing that smoke affected his health, and it is related that a man was hanged in the Fourteenth Century for causing a smoke nuisance. In 1661, Evelyn wrote in his diary of that "hellish and dismal cloud of sea coal which is perpetually over this august and opulent city of London." At the beginning of the Eighteenth Century a poet, describing a London fog appealed to science to

"Make all our chimneys chew their cud,
Like hungry cows, as chimneys should."

In this country during recent years the menace of smoke has become more acute owing to the increased consumption of coal and the concentration of dwellings and factories in larger groups. Since the increase of smoke has kept pace with the development of industry, a chimney belching forth black clouds is sometimes regarded as a symbol of prosperity, and if such waste were unavailable it might indeed be regarded as a necessary nuisance.

Experiments conducted by the United States Bureau of Mines, as well as demonstrations by heating engineers throughout the country, have shown that even with soft coal it is possible to reduce the smoke from domestic furnaces from 50 to 75 percent, merely through proper methods of handling. In industrial plants and railroad locomotives, smoke prevention is a question of management, engineering judgment, and designing skill. There is certainly no more reason for putting up with the pollution of the air we breathe than there is for drinking impure water or eating poisoned food, and as soon as the public becomes thoroughly aroused to this fact and demands smoke abatement, real results will be accomplished.

It would seem that the damage to property, vegetation and health which can now be definitely traced to the effect of smoke would be sufficient to cause all those living in communities subject to this nuisance to insist that every effort be made to abate it. It must be admitted, however, that progress in this direction has been exceedingly slow and that relief can come only through the repeated reiteration of facts which have long been familiar to those who have paid attention to the subject.

Few people have any idea of the immense and varied damage done by the products of incomplete combustion which we popularly term "smoke." The "black smoke tax" is levied on buildings, furniture, hangings, wall paper, paint, goods in shops and warehouses, and all similar commodities. Definite figures are available both in this country and abroad which prove that the loss of property due to excessive smoke runs into millions of dollars every year.

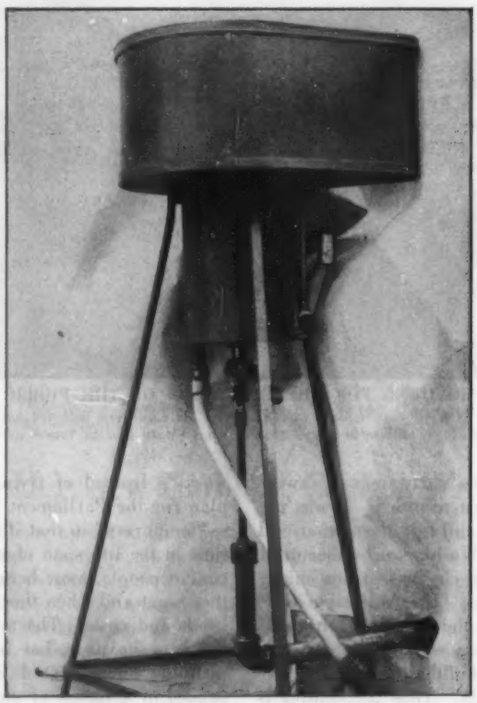
Much more difficult to estimate is the value of trees, shrubs and other vegetation destroyed by the soot and poisonous gases emanating from chimneys. Botanists investigating the damaging effects upon vegetation due to a smoky atmosphere have come to the conclusion that sulfuric acid, readily produced from the sulfur in coal, is one of the principal causes of injury because of its cumulative action.

In addition we have various other products of the distillation of coal that are toxic to plants, but the effect of which is more obscure. The deposit of a coating of finely divided carbon mixed with tar-like substances is certainly likely to reduce the general vitality of a plant and make it more susceptible to the attack of fungi. Even though the plant or tree may not immediately be killed, the effect upon its rate of growth and blooming is marked.

One naturally asks, if the effect upon plant life is so deleterious, what must be the effect upon man? Every day we breathe into our lungs a quantity of

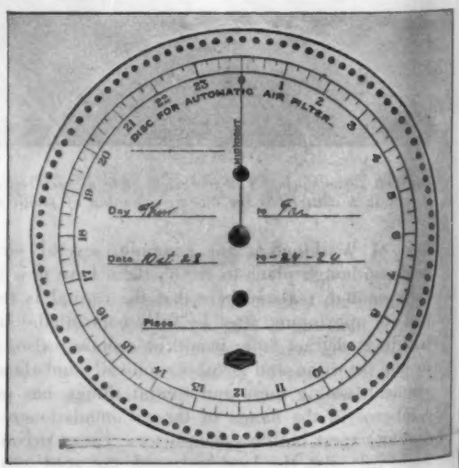
INTERIOR OF OWENS FILTER

This is the same instrument shown on the right. About every 10 minutes, the soot is automatically filtered out of approximately two quarts of air and deposited on filter paper



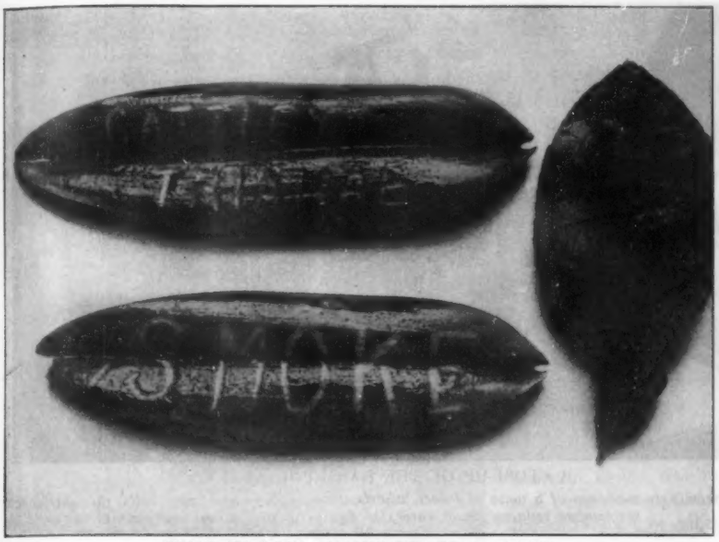
OWENS AUTOMATIC AIR FILTER

The invention of this piece of apparatus has changed the study of the smoke nuisance and its sources from guesswork to a quantitative and qualitative science



A DAY'S RECORD OF POLLUTION

The ring of dots near the edge of the disk shows the relative amount of suspended matter in the air for a single day. A new dot is recorded about every 10 minutes



WHAT ST. LOUIS SMOKE DID TO A PLANT

Six months' accumulation of soot on leaves of an orchid in the Missouri Botanical Gardens. The coating is so thick and dense that it proved possible to incise the scientific name of the orchid in it. Under such conditions, what chance has a plant?

CONTRAST THESE TWO BEGONIA PLANTS

The one on the right is a normal, healthy plant, but the one on the left has been exposed to air ladened with the products of incomplete combustion of fuel which we refer to, collectively, as "smoke." Worse yet, smoke chiefly represents wasted fuel

air that weighs seven or eight times as much as the food and drink which we consume. Elaborate precautions have been taken in this country to insure the purity of food and every up-to-date community protects its water supply from pollution. Yet we continue to disregard the fact that in the course of a year some seven or eight tons of air pass through our system, and little attention is paid to whether or not it contains substances harmful to health.

Amount of Damage Not Fully Appreciated

Unfortunately there is not at present the mass of experimental evidence demonstrating the evils of human beings breathing the smoke-ridden atmosphere that there is for plants. However, such information as is available indicates that there is a serious pathological effect, particularly in acute lung diseases. Some authorities regard the cutting off of efficient rays of sunlight as even more harmful than the breathing of poisonous gases. An old Italian proverb says: "All diseases come in the dark and are cured in the sun."

That sunlight kills certain disease germs has long been known but the medical profession now recognizes the necessity for keeping the atmosphere as clean as possible in order that the ultra-violet and other short-wave rays may not be filtered out. One has only to see the effect upon chickens or other animals which have passed their entire existence behind window glass, and consequently have never been exposed to these beneficial rays, to realize how fundamental it is that we get the full effect of all of the light which comes to us from the sun.

One reason the public in general does not realize the extent of the damage due to the presence of smoke is because it has been so hard to get any accurate method of measuring the pollution of the atmosphere. While a heavy cloud of smoke is obvious to everybody, a refined method for demonstrating its presence even when it is not visible to the naked eye, has only been developed within recent years.

At the International Conference on Smoke Abatement held in London in 1912, Dr. John S. Owens pointed out that little progress could be made in the prevention or reduction of smoke until some accurate data could be obtained as to its quantity and the time, both of the day and the year, when it was most abundant. Such methods as had previously been used depended entirely upon the collection of soot and suspended matter as it settled out of the air into a container. Obviously these were subject to so great error that no real conclusions could be drawn from them.

By 1917, Dr. Owens had developed an automatic recording apparatus for the measurement of suspended matter in the air, which has done more to put the whole matter of smoke abatement upon a scientific basis than any other single thing. This instrument makes use of a circular disk of filter paper, divided into hours, which is caused to revolve by a clock. Through this disk, by means of a perforated plug about one-eighth inch in diameter, two liters of air are slowly drawn, as water in a tank connected to the plug gradually runs away. At the end of about ten minutes, when the tank is empty, the clock moves the disk to a fresh point. The tank rapidly refills and the process is repeated throughout the 24 hours. Thus there is obtained on the paper, with a record of the time of day at which the sample was taken, a permanent spot which, according to the degree of blackness shown, indicates the amount of impurity in the air at that particular time.

THREE DAYS' SMOKE DID THIS

Compare the drooping foliage of the chrysanthemum on the right with that of the other plant, which was grown outside of the city of St. Louis

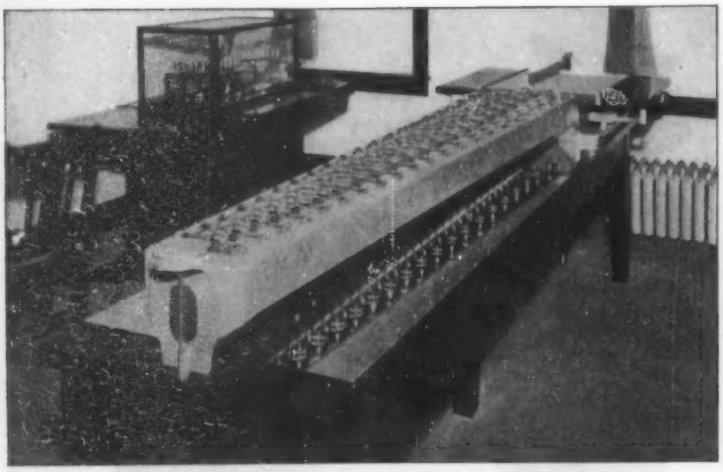
While it would obviously be too great a task to attempt, by weighing each sample, to determine the quantity of impurity, an ingenious color scale devised by Dr. Owen makes this both rapid and simple. This scale is made by laying on successive layers of lampblack on white paper, producing a series of shades from 1 to 20. Each succeeding number indicates twice as much impurity as does the previous one. A hole in the middle of each square of color permits the record obtained from the machine to be examined in immediate proximity to the various shades, and thus an extremely accurate comparison can be made.

Records at 10-Minute Intervals

The value of the different numbers in terms of milligrams of impurity per cubic meter were obtained experimentally by weighing disks through which known volumes of air had passed. Thus one can read as accurately with the assistance of this scale the amount of impurity in the atmosphere at a given time as though each sample had been weighed. With such an instrument a record of the condition of the atmosphere can be made at about 10-minute intervals throughout an entire year, and if kept through successive years these records should throw a flood of light upon the smoke situation in any community.

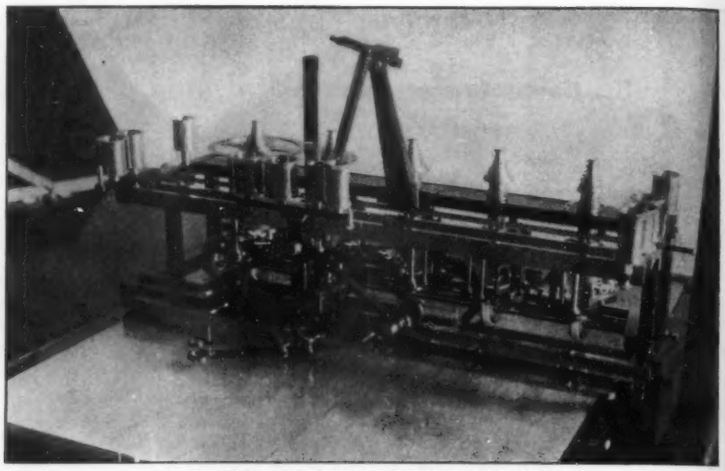
After tabulation, curves can be plotted showing the distribution of impurities. Valuable information as to the time of day, the day of the week, or the season at which smoke is most prevalent in the air is thus made available. By this means it is possible to demonstrate whether the majority of smoke is from domestic fires or from certain industries. In fact, many questions which have not heretofore been answered, such as the time of day or week or year at which the maximum and minimum amounts of smoke are present and the effect of rain and wind can be determined, and numerous other fundamental problems involved in any accurate survey of the polluted atmosphere of a city can be solved.

Controversies are always interesting and when they bear on subjects of wide interest, they are doubly so. In our next issue will appear the concluding arguments on the physics of golf balls by Prof. Sheldon and P. A. Vaile, which started with an article in our August, 1926 issue.



THE SYNTHESIZER AND THE HARMONIC ANALYZER

On the long table is the synthesizer which reconstructs sound curves from the readings that have been set up on the harmonic analyzer shown in the background



A CLOSE-UP OF THE HARMONIC ANALYZER

Seemingly made up of a maze of levers, wheels, belts, pulleys and glass balls, this intricate mechanism reduces sound curves to figures of the various components

Yardsticks of Sound

Sounds Are Now Reduced to Exact Mathematical Formulae and Reproduced at Will in the Acoustic Laboratory

By Austin C. Lescarboura

IMAGINE a steel fork worth several times its weight in gold! Plain steel, plain design, plain workmanship—at least so far as the most critical eye can detect. It is a two-pronged fork, with a short, stubby handle and thick, square prongs. Today this precious steel fork reposes in a silvery cabinet, with glass top and sides, and receives the respect accorded a rare relic. Occasionally it is carried by tender hands to a well-lighted hall where, surrounded by serious sages and forks of similar design, it is struck so that its penetrating wail may be heard far and wide.

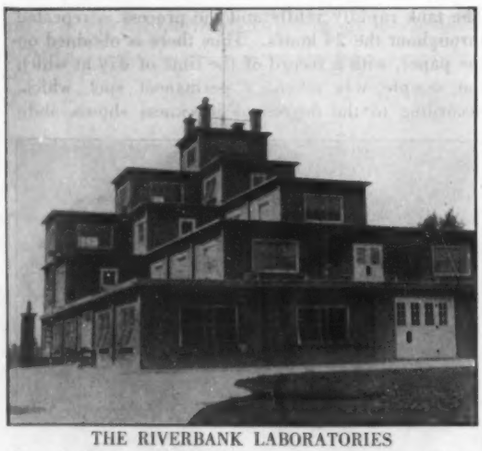
But enough of mystery! The fork in question is none other than the world's master tuning fork—at least it is claimed to be the most accurate tuning fork extant, by Colonel George Fabyan, in whose Riverbank Laboratories at Geneva, Illinois, this scientific marvel has been produced. This master fork, along with many other tuning forks in use or in the making in this institution, constitutes a standard of pitch, just as the platinum bar reposing in Paris constitutes the world's standard meter.

"Stirring Up" Solid Steel

The Riverbank master tuning fork, as with most tuning forks, fails to give even an inkling of the amount of skill and effort that went into its production. This steel form represents in its fashioning, tuning and polishing, at least 60 solid days of the most accurate craftsmanship and scientific procedure, while the total elapsed time was of the order of 18 months.

When used for a tuning fork, a mass of steel cannot be handled on the basis of "just so much metal." In their relation to accurate musical pitch, the molecules in the mass of steel for the fork-to-be act like so much mud in water which is stirred up every time the water is disturbed. Similarly, the molecules in the steel are easily "stirred up." Even with nothing more violent than the most gentle rubbing of the end of a prong with a bit of emery cloth, several hours are required for the "muddiness" or unsettled condition of the molecules of the metal mass to disappear, while the severe shock and upheaval of filing or other major machining, would persist for two weeks or more. Hence the considerable time required in the making of a precision tuning fork.

The pitch of a tuning fork is determined by the mass of metal in the prongs and down to the curved portion that leads to the handle. The handle itself plays no important rôle in the pitch, so that the clamping of the handle has no effect other than to alter the duration of the fork's sustained note. The



THE RIVERBANK LABORATORIES

One of the several buildings that constitute these laboratories where studies of sound and tuning forks, such as described in the text, are undertaken

vibrations of the fork can be transferred to other objects which will in turn vibrate to the same pitch, and with a volume depending on how much they are in sympathy with the pitch of the vibrating tuning fork.

In making a tuning fork of given pitch, the operation starts either with a drop forging or hand forging, roughly shaped to the approximate size and outlines of the ultimate fork, or with a solid block of metal which must be cut to shape and then carefully ground, rubbed and polished.

The master tuning fork at Riverbank is rated at "256 DV," which means that, when set in motion by a blow, its prongs will sway at the rate of 256 double vibrations per second, producing a note equivalent to the middle C of the musical scale of the physicist. Temperature, of course, influences the pitch, especially when dealing with such precise values. Rising temperature decreases the pitch, which is rated at 256 DV only when working at a temperature of 68 degrees, Fahrenheit (or 20 degrees, Centigrade). Correction factors permit of making due allowance for changes in temperature, so that the fork may be used accurately at any temperature.

Few things are as delicate as a master tuning fork, despite its husky appearance. An invisible dent or tiny fleck of rust or corrosion on the prongs, due to careless handling or perspiring hands, would instantly change the pitch of the fork, even though only a fraction of a vibration per second. It would then no longer be a physical standard. The prongs are the most sensitive members, since they provide the elasticity which, in turn, determines the pitch. Even atmospheric conditions must be guarded against. To this end, the highly polished surface is coated at all times with light oil to prevent rust, and is carefully protected against mechanical injury.

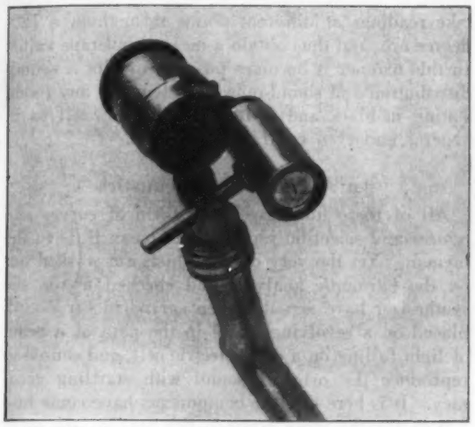
141,000 Audible Vibrations

A master tuning fork is always struck with a soft, rubber hammer. However, to provide maximum protection, the Riverbank fork is enclosed in a metal case, with glass top and sides, and with a resonator chamber below, so that the sound may be plainly heard even though the source of the sound is fully protected. The master fork is set in vibration by a pair of arms which, when the knob outside the case is turned, spread the prongs of the fork apart and suddenly snap back, setting the fork vibrating. Thus the fork is protected from careless handling, and the actuating force is always uniform.

In order to gain the title of master tuning fork, extreme precision has had to be achieved. According to Bert Eisenhour of the Riverbank Laboratories staff, a classroom tuning fork is considered sufficiently accurate if it loses or gains one vibration in 750 of the indicated rating. The Riverbank master

fork, on the other hand, loses or gains but one vibration in 500,000!

Quite aside from the matter of accuracy, there is the important requisite of sustained effort, or duration of the vibrations, especially in standardization work and advanced laboratory practice. It is the size or mass of the tuning fork, rather than its pitch, that determines its sustained effort, since it is possible to secure almost any pitch with any size of tuning fork, provided the metal is properly distributed. The Riverbank fork has a duration of nine minutes and 13 seconds, which, in terms of the vibrations themselves, means a total of 141,000 audible vibrations or more. This may be contrasted with a minute to two and one-half minutes for the best German tuning forks, or something like 15,000 to 34,000 vibrations.



EYEPIECE AND LAMP-HOUSE OF PHONOMETER

Note the narrow slit through which a light beam is flashed to the vibrating mirror situated within the device

Not content with such achievements, a new fork is now under way at this institution, using elinvar, a French alloy steel. This master fork will materially excel the performance of the present Riverbank standard. Its accuracy will be of the order of one part in a million and a half—one vibration gained or lost in 1,500,000—while the duration will be nine minutes and 56 seconds at 256 double vibrations per second, or something over 145,000 audible vibrations in all. Placing the master tuning fork in the metal case, with a resonator directly coupled, serves to intensify the sound, but this also reduces its period from over nine minutes to something like two minutes. However, for all practical purposes this period is sufficient, especially with the greatly increased volume due to the resonator.

It is in the final tuning of the master fork that the work is most precise and even tedious. Due to the "stirring up" of the molecules, only a tiny bit can be done at a time. The fork of known pitch and the fork being tuned are mounted at right angles to each other on a stout steel plate. A delicate wire, quite as fine as the finest hair, serves to couple the prong of one fork with the prong of another, and carries a shiny glass bead of almost microscopic dimensions. This bead rests in the field of vision of a powerful microscope. The work of tuning consists of removing just a trace of metal from the ends of the prongs at convenient intervals, with emery cloth, and then observing the results by means of the microscope and the oscillating glass bead. When the tuning forks are of equal pitch—which also means in perfect step—the glass bead will sway back and forth in a straight line, because of the uniform motion of the coupling wire, showing a straight streak of light in the microscope. When, however, the forks are of different pitch, or out of step, the glass bead does a scientific dance, resulting in a cycle of straight lines and curves from which, by means of a stop watch, the difference in vibration and therefore of pitch between the two forks, may be ascertained.

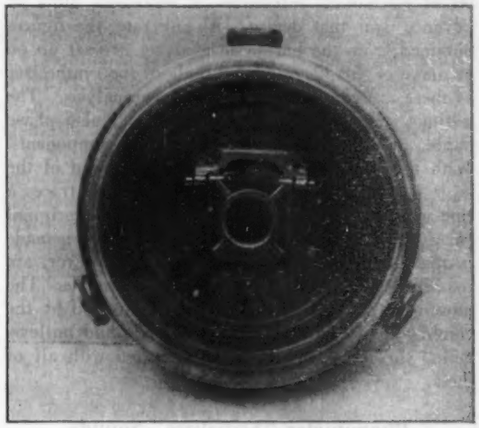
Handle With Care!

So, day after day and month after month, the maker of precision tuning forks fondly rubs the metal prongs with a bit of emery cloth, strikes both forks with a soft, rubber hammer, and studies the antics of the glass bead with stop watch in hand. Finally, after proceeding by infinitesimal shaving operations of one one-hundred thousandths of an inch, the forks are in step and the work is completed.

All kinds of tuning forks are to be seen at Riverbank, both in the finished form and in the making. Among others are those comprising a complete assortment from 512 DV to 4,096 DV, in steps of 128 vibrations. These tuning forks, as with others of equally high caste, are handled only with gloves and are struck only with prescribed soft, rubber hammers. When not in use, these forks are kept in a glass case and are covered with a thin coating of oil.

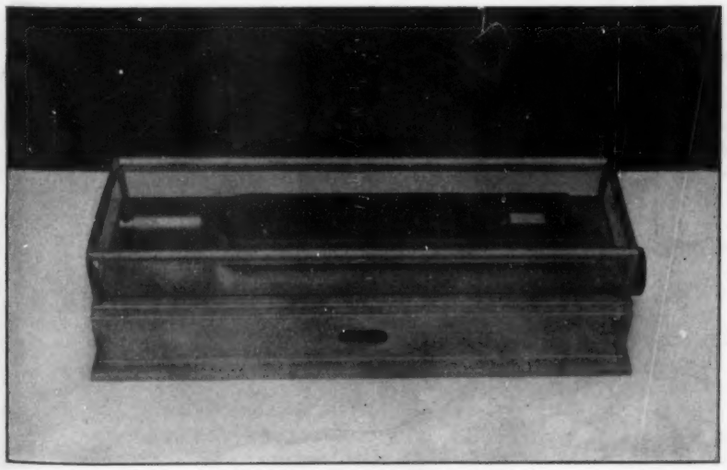
Tuning forks are the basis of a vast amount of scientific effort that must go into the study of sound. Now sound, as every schoolboy knows, is the result of vibration in objects and in air. Sounds are heard because vibrations, imparted to the air by vibrating objects, strike the human ear-drum which is set vibrating, and the vibrating ear-drum in turn communicates the effect to the brain where it is duly translated into certain sensations. Music, which we readily enjoy without stopping to think what it is all about, consists of a veritable riot of vibrations of all kinds and powers, producing the desired nerve stimuli in the listeners. Even the simplest musical note, such as a single note from the violin, consists of a combination of vibrations, with a predominant vibration to produce the fundamental pitch. It also has many subsidiary vibrations which produce the overtones and harmonics so essential for giving the timbre which characterizes a violin from other musical instruments, and even a Stradivarius from a mail-order special.

Among the many ingenious devices employed in the study of sound in the acoustic laboratory, is the harmonic analyzer—an intricate assembly of pulleys and cords, glass balls and celluloid scales, levers and hinges. A given sound is reduced to a graphic curve by means of other devices, such, for example, as the oscillograph camera. The graph is placed on the harmonic analyzer, and as the stylus of the analyzer is moved over the curve, the components that go to make up that particular curve and its particular sound are registered on recording dials, just as the ever-watchful electric meter keeps tabs on our consumption of electricity without encouragement on our part. Readings are obtained for the various components of the curve, even up to 40 components. We are told that, in determining the real constitution of the sound, readings up to ten components are quite crude and insufficient; 20 components is passable; 30 components is fair; 40 components is good; and 50 components means accurate analysis even for a fairly intricate wave-form such as that of a violin note.



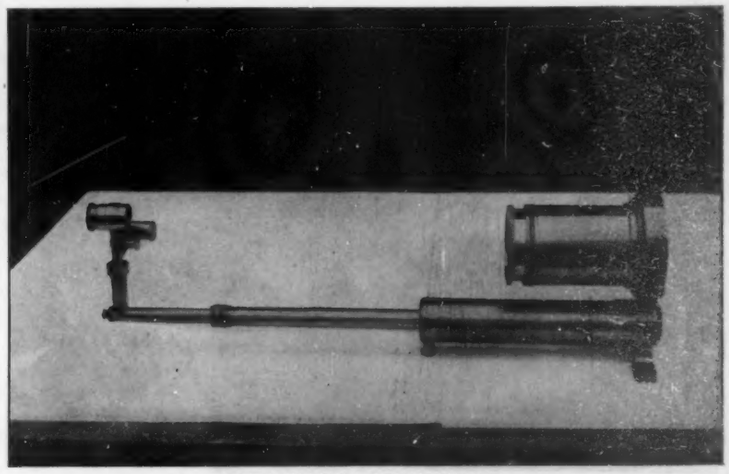
THE HEART OF THE PHONOMETER

This shows the wires holding the disk which vibrates the mirror of the device, thus reflecting light to a scale



CAREFULLY GUARDED FROM HARM

This is the master tuning fork which is set in vibration only by means of the knob at the right which spreads the prongs and suddenly releases them



THE COMPLETE PHONOMETER

In this close-up of the phonometer, the resonator chamber and the battery holder are at the right and the eyepiece and the lamp-house are at the left

The intricate array of figures obtained with the harmonic analyzer must be checked over in order that the findings may be considered final. Heretofore, such checking up has called for mathematical ability of no mean order, plus a great deal of time. It has remained, however, for Mr. Eisenhour, of the Riverbank Laboratories staff, to develop a machine which does the checking up at the mere turning of a crank! The machine, which has been named the "synthesizer," comprises a vast array of wheels, pulleys, cranks, gears, and a transmission chain, tracing pen or pencil, crank and heavy base.

In a general way the synthesizer simulates the tide-predicting machine of Lord Kelvin, but, in the matter of mechanical intricacies, it represents quite an advance over that device. At any rate, the figures obtained from the harmonic analyzer are set up on as many of the 42 graduated dials of the synthesizer as there are components in the curve analysis. The settings stand for amplitude, or power; also phase angle, or difference in time between components. With the dials all set, the crank at the end of the table is turned, whereupon a pen or pencil traces a line which should coincide with that of the original curve analyzed, provided no errors have been made in the analysis and readings. Errors, however, are readily detected and due corrections are made. The movement of the pen or pencil is controlled by the combined action of all of the 42 dials and pulleys, acting through a chain drive connected with all of them.

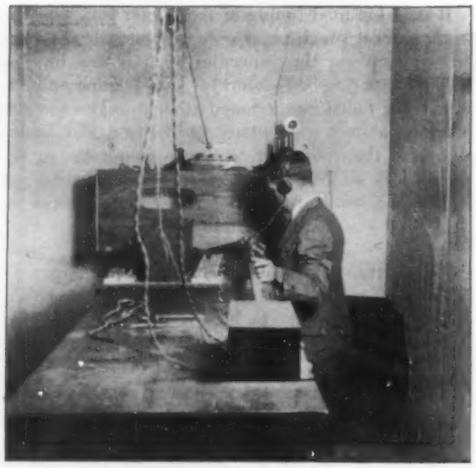
Phonometer "Visualizes" Sounds

The synthesizer measures about nine and one-half feet long over all, with the main body tapering from two feet wide at one end to nine inches at the other. The main frame is of cast aluminum, the gears of steel, and the dials and other parts of stellite, a hard stainless composition which machines well and takes a high polish.

Not content with studying the science of sound amid laboratory surroundings, the staff at Riverbank have worked out ways and means of studying sound action in auditoriums, churches and halls, in order to determine the absorption and reflection of walls, as well as the cause of unsatisfactory acoustics. For this purpose an ingenious device, known as the "phonometer," has been developed. The original idea for this instrument came from the late Prof. A. G. Webster of Clark University. The present improved device has many advantages over the original model, both in scope and convenience, as well as in ruggedness.

The phonometer permits of "seeing" sounds even when they have become too weak to be heard by the most sensitive of human ears. Furthermore, the phonometer gives a quantitative or volume reading, which cannot be expected of uncalibrated ears. Briefly, this instrument comprises a metal disk, suspended by three pairs of taut steel wires. This disk is set vibrating by the sound waves for which it is tuned. By altering the tension of the steel wires, the phonometer may be tuned to maximum response for musical frequencies ranging from 256 to 1,024 DV. The disk is enclosed in a resonating chamber, formed by sliding metal tubes and a plate-glass window, so that the air is attuned to the desired frequency and presents no drag on the vibrating disk. In its vibration, the phonometer disk, working through a tiny driving rod, causes a minute mirror to wobble. This mirror is just about large enough to permit a fly to study her complexion. Against the mirror is directed a tall and narrow beam of light from an electric lamp, and this beam, in turn, is reflected by the tiny mirror onto a graduated scale which is visible through a high-power magnifying eyepiece. Thus the vibration of the metal disk is translated into expanding and contracting ribbons of light on a graduated scale, suggesting nothing so much as an accordion in action.

The intensity of the sound results more or less in stretching of this figurative accordion, and the degree is read off on the phonometer scale. Just so long as a pushbutton is pressed, the beam of light is supplied by a miniature bulb encased in a lamp house beside the eyepiece. Current is obtained from flashlight cells in the tubular base of the phonometer. All in all, the device is entirely portable and self-contained, despite its extreme sensitivity which far exceeds that of the human ear.



IN A PADDED CELL

Here the array of electrical devices shown permits the study of the effects of various sounds on the human ear

It will be noted that the phonometer responds to the sound for which it is tuned, and that it ignores all other noises. Thus it may be used for testing the acoustics of a hall, even though carpenters and others may be at work. In working out sound distribution for auditoriums, a source of sound is employed, such as a calibrated organ pipe. A tuning fork would hardly supply sufficient volume for a large room and would have to be excited too often. The sound once liberated, the phonometer is carried about in the auditorium, so that the observer can take readings at different points throughout a 120-degree arc, and thus obtain a mean or average value. In this manner it becomes possible to plot a sound-distribution and sound-reflection chart for any room, stating in black and white what the ears tell us in general and even contradictory terms.

An Aid to Better Acoustics

All of these findings, in the form of curves and figures and scientific reports, may mean little to the layman. Yet the very curves which are worked out on the harmonic analyzer and checked up on the synthesizer have actually been carved in cardboard, placed on a revolving wheel in the path of a beam of light falling on a photoelectric cell, and caused to reproduce the original sound with startling accuracy. It is here that the components have come into action, for the more accurate the profile—the more little twists and turns are included, as the result of including more components—the more realistic is the reproduction.

The lessons learned in making observations on walls, draperies, furniture, architectural design and other things have served to produce better acoustic results in our homes, churches, auditoriums, theaters and even the broadcasting studios.

So in conclusion, we find that veritable yardsticks have been produced for the measurement of what has hitherto been one of the most elusive of nature's forces—sound. And with yardsticks in hand, the scientist can now advance to a better and still more practical understanding of sound, and to a vastly improved application of those intricate vibrations whose charms have been known to soothe the savage beast.

¶ *A new type of turbine-driven locomotive which holds many interesting advantages over those in existence at the present time will be the subject of a fully explanatory article that will appear in the June issue of this magazine.*

STUDYING A TUNING FORK

The operator is employing the phonometer described and illustrated elsewhere in this article. This device translates sound waves to indications that are visible

COMPARING TWO TUNING FORKS

Here the scientist is making observations of the difference in pitch between a standard tuning fork and another that is still undergoing the intricate forming process

Inventors Who Have Achieved Commercial Success

In the Fifth Interview of This Series, an Inventor Tells How Ordinary Air Proved to Be a Stepping-stone to Prosperity

By Milton Wright

"WHAT do you consider the most necessary qualification for successful inventing?" we asked Gregory J. Spohrer.

"Thorough knowledge and experience," he replied without an instant's hesitation. "A man may hit upon a good idea in a line he knows nothing about, but if he is going to do any considerable amount of inventing—especially in a competitive field—he ought to know as much as everybody else knows, and, if possible, just a little bit more."

Gregory Spohrer ought to know something about inventing. Widely recognized as an authority in the field of compressed air, he has 65 patents to his credit. Some of his inventions were declared impossible by compression engineers when first he proposed them; now the very corporations which once rejected his ideas are among the biggest buyers of apparatus bearing his name.

"But how did you come to make your first invention?"

"With another fellow I started in the automobile business in Joplin, Missouri. We had a general sales agency for two makes of cars and we did auto repair work. I could not help being impressed by the thought that people were wasting a lot of time and energy in cranking their motors. Why should there not be an automobile-starter to turn the engine over? To invent such a starter was a job for a mechanical engineer. That is what I was, so I elected myself the inventor. My starter was an air ram with a rack running over a pinion."

"But how did you make any money out of it? Put up your own capital to promote it?"

"No, I had very little capital in those days. Through an advertisement which I put in a motor magazine, I got in touch with John A. Wilson, Woodrow Wilson's cousin, and through him with United States Congressman Joseph E. Sibley. After I had demonstrated the starter to them, Mr. Wilson offered me 10,000 dollars for a half interest in my invention, and, in addition he would pay all the promotion expenses. How could I refuse an offer like that?

"We organized the Wilson Motor Starter Company and put starters on autos on order. A lot of Pierce Arrow owners bought them. It was the first automatic starter ever to go on an automobile. Later I sold out my remaining half interest for 10,000 dollars.

IN THE FACTORY

This view shows a part of a factory in which are made air compressors of a type invented by Mr. Spohrer

GREGORY J. SPOHRER

By combining a thorough training in mechanics with inventive ability, he has trod the road to commercial success

"But you had something to do with airplanes. How did you happen to break into that field?"

"Well, I have found—and I guess other inventors have had the same experience—that one invention leads to another. While I was making automatic automobile-starters I had a notion for an automatic starter for motor-boat engines—one unit for all installations. I built a model, attached it to a Pierce Arrow engine and hired a booth at the Motor Boat Show. This was just before the World War. A man I had never seen before came along, stopped at my booth and seemed keenly interested in what I had. It was Mr. Kirkham, chief engineer for the Curtiss Company.

"'Ship me a unit to Buffalo and let me try it out on an airplane,' he said. The test worked to perfection. In less than a week they had me in Buffalo, with all the facilities of their plant at my disposal, designing a starter to fit a Curtiss engine. Within ten days I had it completed and immediately we got an order from the Government for 250. Later we filled thousands of orders. There was no selling problem; it was just a case of working day and night making them. It was the only self starter for airplanes at that time. It was used on Liberty motors. The Russian and English governments bought it, too. Altogether I made about 40,000 dollars out of that invention. Just after the war started I sold out to the Motor Compressor Company."

"And then you turned to automobiles again?"

"Not right away. I wanted to play for awhile. For a solid year I spent all my time out on the golf links. Once, while out on the course, I got talking to a man who was with the Goodyear Company. He told me about the difficulty they had inflating heavy pneumatic truck tires, with engine-driven transmission-mount pumps.

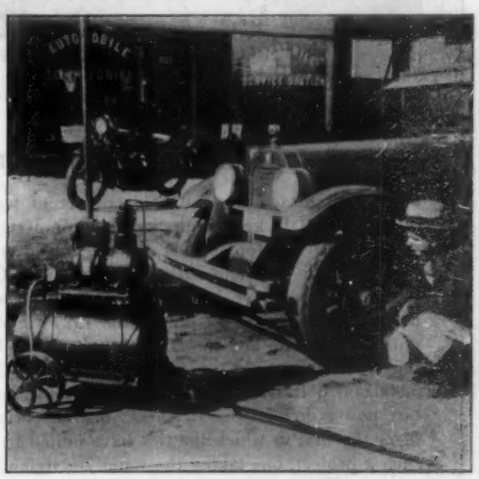
"'Why don't you get into the game?' he asked. It looked interesting so I got busy. There already were pumps but they would get so hot that they burned up before they filled one of those heavy tires. I developed a double-acting pump attached to a standard opening in the transmission in which the oil in the transmission was circulated to the bottom of the cylinder, thereby carrying away the heat. It weighed 11 pounds and it would fill a giant pneumatic tire in seven minutes."

"That invention was quite a success, was it not?" we asked the inventor.

"Well, the invention was all right, but air-filled tires for trucks were not a success at that time," he replied, "so I developed a compressor that could be used as a garage pump. As I saw it, such pumps as were in use were all wrong. Away back in the days when they first began to use them, they revolved them at 300 revolutions a minute. They were attached to motors with a standard revolution of 1,725. The gear reduction that was necessary to bring the motor rate down to the pump rate resulted in all kinds of troubles. So far as I could see, there was no mechanical objection to a pump running at 1,725 revolutions per minute.

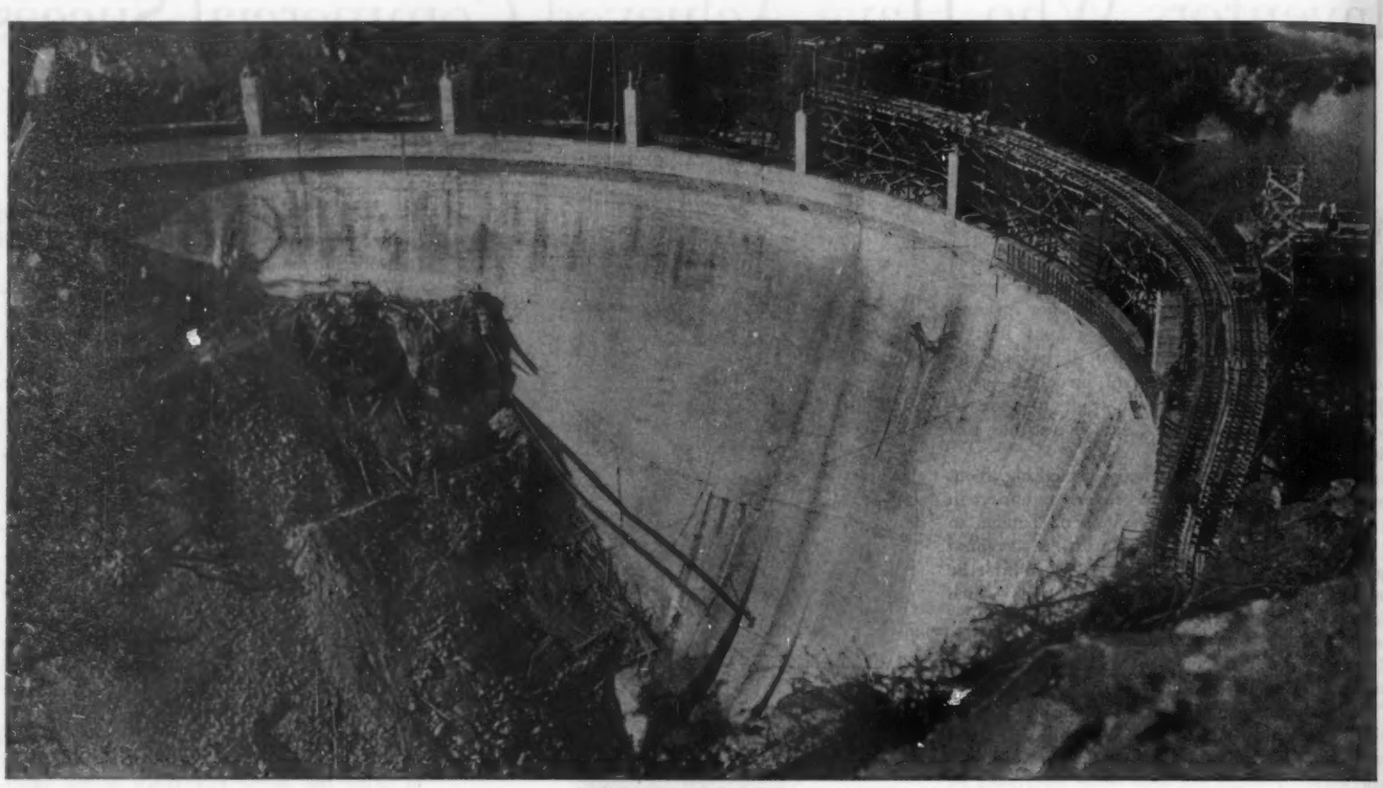
"'They will shake themselves to pieces,' declared engineers of some of the biggest corporations in the country. They would not let me build one with their facilities, because they would not believe that an air compressor could run so fast. That was all right with me. If the big companies did not want to make them, I would make them myself. I bought General Electric motors, put my compressors on them, and sold them in competition with devices already on the market. It proved even better than I expected. It was more efficient than the others and I could sell it for half as much.

"I was fortunate in having something the public could see value in. Where you enter into competition with old, established firms, you have got to have something that is simpler, cheaper and better. If you have such an article, then the public will sit up and take notice."



AT THE GARAGE

The motorist is making use of one of the small, high-speed air compressors such as are described in the text

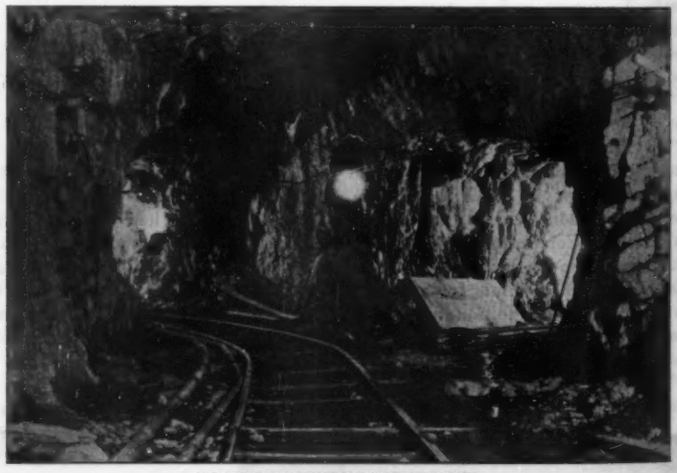


GENERAL VIEW OF MELONES DAM IN TUOLUMNE COUNTY, CALIFORNIA

This arch-type dam makes possible the storage of 112,000 acre-feet of water, which is to be used for two irrigation projects as well as for the generation of 36,000 horsepower of hydro-electric energy. This dam has the feature of gates at the top which can be employed to raise the effective height of the dam by 12 feet

THE NEEDLE VALVES FROM THE TUNNEL

These valves release the water from the tunnel leading to the power house, into the lower reaches of the Stanislaus River

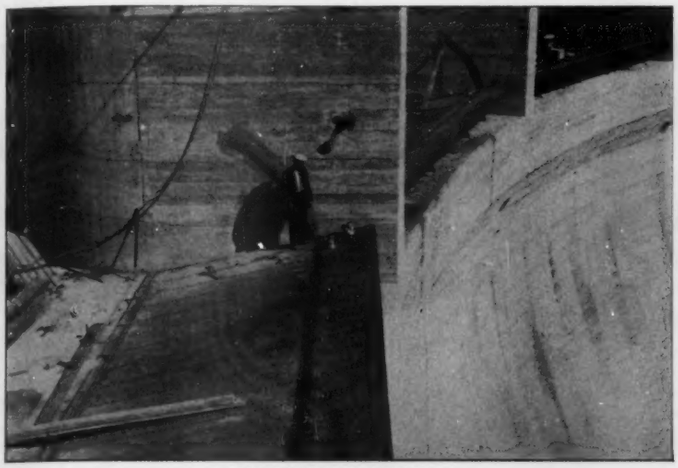


IN THE POWER-HOUSE TUNNEL

This tunnel has a capacity of 1,500 second-feet and slants sufficiently to eliminate the necessity of a penstock at the power house

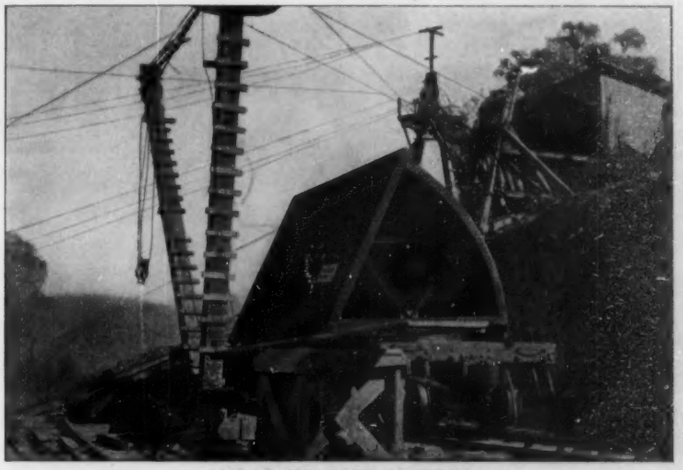
Irrigation Water and Electric Power From Same Storage Reservoir

Providing storage for 112,000 acre-feet of water for irrigation purposes for the Oakdale and south San Joaquin irrigation districts, and making possible the development of 36,000 horsepower of hydro-electric energy for the Pacific Gas and Electric Company of California, Melones Dam on the Stanislaus River in Tuolumne County, was completed recently and will begin storing water during the 1927 runoff, according to F. T. Humphrey. The dam and the accompanying tunnel and power house are costing the districts and the power company an initial investment of almost 5,000,000 dollars. While a number of instances where power companies buy power direct from irrigation districts occur in California, this seems to be the first in which the two have united by contract in the building of such a project, one taking the water for irrigation and the other taking the power. The two irrigation districts, which comprise 146,000 acres, have built the dam at a cost of approximately 2,200,000 dollars, while the power company is now completing the tunnel to the power house and the power house proper at a cost of approximately 2,750,000 dollars. The power company has also agreed to pay the irrigation districts 5,175,000 dollars for the power privileges in semi-annual payments of $64,687.50, or more than enough to pay the interest on the project and retire the bonds. While Melones Dam is one of the smaller works of its kind when compared with Don Pedro, Exchequer, Hetch Hetchy, Shaver Lake and other projects recently completed or now under way in the west, it has the distinction of being one of the two highest-overflow storage-dams in the United States. It is a gravity-type structure, 214 feet high, 595 feet long at the crest and ranging in thickness from 112 feet at the base to 24 feet at the top. Ninety thousand cubic yards of concrete were used



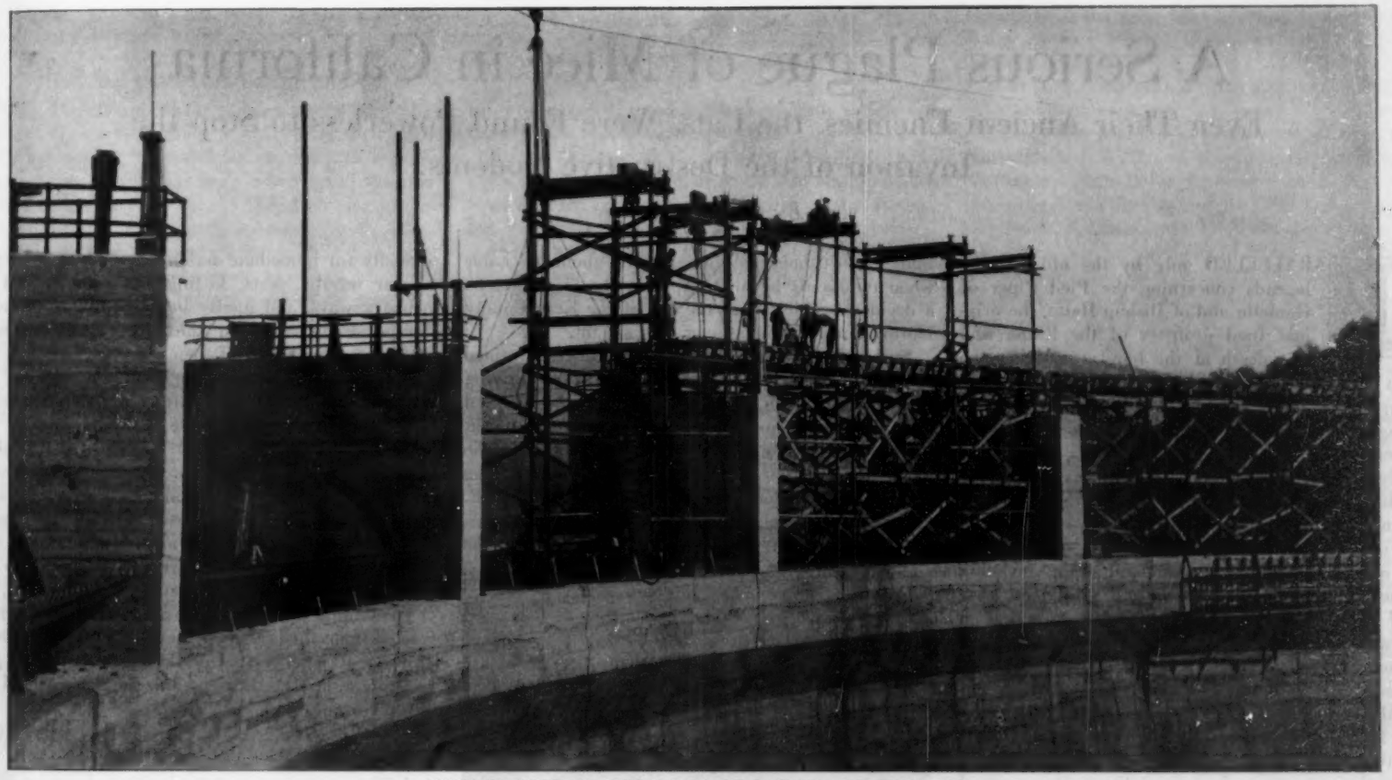
THE GATES AT THE TOP

These steel gates make it possible to raise the height of the dam when water is spilling over. This view shows one of them partially completed



ONE OF THE GATE SECTIONS

Each section weighs 40 tons. They are arranged to be raised by water pressure or, if this should happen to fail, by means of turbines



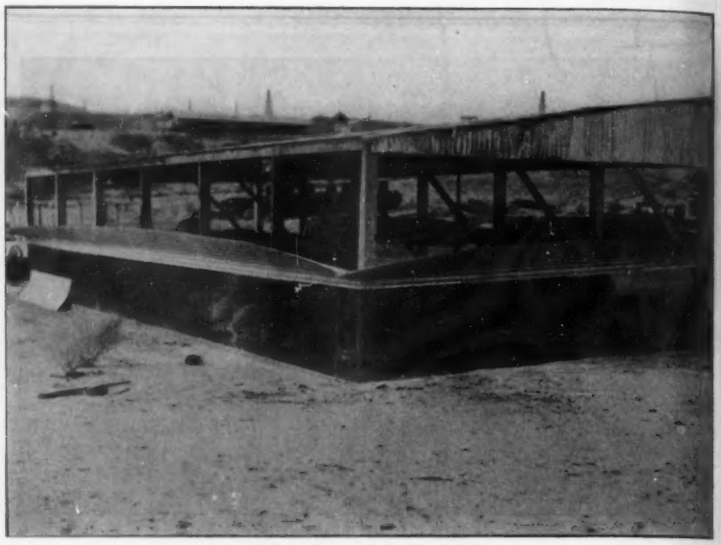
ANOTHER VIEW OF THE GATES AT THE TOP OF THE DAM

This photograph shows how the huge steel sections fit in specially constructed recesses in the top of the concrete dam. The two parts seen at the extreme left are complete, while the recesses at the right are still under construction. This method of raising the height of the dam will save large quantities of water

in building it. The dam is arched against the stream. One of the most interesting features about Melones Dam is the series of steel gates across the top of it by means of which the height of the structure may be raised 12 feet when water is spilling over the top. These gates, each of which weighs 40 tons, are in the shape of segments of a cylinder, made water-tight, and hinged so that they normally rest in recesses in the top of the dam, with one edge forming the top of the dam proper. When water is flowing over the top, and it is desired to raise the gates for additional storage, valves in the side of the dam are opened and water under pressure from the reservoir rushes in under the gates, raising them into position so that the total height of the dam is increased 12 feet. As an added provision for handling the gates, in case the water-pressure method fails, a turbine has been installed and power may be applied at will. Melones is the only overflow storage-dam of any size in California. All other dams provide spillways for the escape of the water after the reservoirs are filled, but in this case the water must either flow over the top or pass through the tunnel which leads almost a mile through the rock of the canyon to the power house. Six gates, each two and one-half by ten feet and controlled from the gate house on top of the dam, cover the outlet into the tunnel. The first 415 feet of the tunnel was constructed by the district while the rest was done by the power company. The district's part of the tunnel has a capacity of 1,700 second-feet while the power company's part has a capacity of 1,500 second-feet. Instead of having a steel penstock slanting down to the power house, sufficient fall is obtained from the tunnel to turn the turbines. An indication of accuracy in the drilling of the tunnel, which runs at seven different angles, is the fact that headings from the two ends came within a quarter of an inch of checking when miners broke through. In connection with the project, it was necessary for the district to do 50,000 dollars worth of work to protect the little town of Melones, which otherwise would have been engulfed by the rising waters.

THOUSANDS KILLED BY AUTOMOBILES

At one time, the highways in Kern County, California, were slick with the crushed bodies of mice. Each spot in this photograph represents a dead mouse



GRAIN PROTECTED FROM MICE

This structure is one of the many mouse-proof granaries that were built in an endeavor to save grain that lay in the path of the invading hordes of hungry mice

A Serious Plague of Mice in California

Even Their Ancient Enemies, the Cats, Were Found Powerless to Stop the Invasion of the Destructive Rodents

By F. T. Humphrey

PARALLELED only by the old German legends concerning the Pied Piper of Hamelin and of Bishop Hatto, the original food profiteer of the Rhine who met death at the hands or rather the teeth of rats, a gigantic invasion of mice recently occurred in Kern County, California, which has engaged the attention of the entire state and in fact the entire nation.

First hundreds of mice, a nuisance; then thousands of mice, an infestation; then literally millions of mice, a veritable pestilence, have swarmed up out of the bed of Buena Vista Lake, over-running the oil fields, destroying seed and grain, invading homes, making the highways slick with their mangled bodies. The invasion is without precedent in the west. No one has been able to explain it satisfactorily.

This enormous army of invading rodents has puzzled the California Department of Agriculture and has finally arrested the attention of the experts of the United States Department of Agriculture which has sent its rodent specialist to the scene of infestation to act as a modern Pied Piper and to help stamp out the plague.

Poison Accounts for 5,000,000

Estimates of county, state and United States officials as to the total number of squirming, squealing, gnawing pests that have come up out of the dry lake-bed have varied from 30,000,000 to 100,000,000. Certain it is in any case that the mice have multiplied amazingly in the 30,000 acres of the lake-bed, for the past three dry years, running as high as 4,000 to the acre. These mice, beginning about Christmas time, and for some unaccountable reason, migrated almost in a body, leaving the lake-bed like rats leaving a doomed ship.

When the rodents first made their appearance in unusually large numbers, employees of an oil company near the lake-bed (the lake is in a sparsely settled oil-bearing region) took ordinary precautions against them and thought little about it. Later when thousands began to appear, the mice became a decided problem, and the aid of the Kern County Horticultural Commissioner was sought.

Still later, when millions of the creatures swarmed over the oil district and headed for Taft, a thriving little oil city of 5,000 population, help was asked from the State Department of Agriculture which sent an expert out to aid in the fight and to study the unusual problem. Still later, aid was asked of the United States Department of Agriculture and S. E. Piper, rodent specialist, was assigned to the job.

Puzzled by the phenomenon, yet faced with the necessity for immediate action, the authorities began to war on the pests, killing what they could in ordinary ways, and finally bringing about a wholesale poisoning campaign which has already accounted for over 5,000,000 of them.

THREE TYPES OF MICE

LEFT TO RIGHT: *the house mouse, the meadow mouse and the field mouse, all found in the invasion*

Some 50 miles of trenches were dug between the lake-bed and the city of Taft. Into these trenches tons of poisoned grain were scattered and as the invading rodents reached the trenches and feasted, millions of them died. The problem of removing the dead mice was then encountered, and tubs, barrels and finally trucks were used to move them away. The dead lined the trenches and the immediate surrounding territory with an average of 85,000 to the mile and from them a nauseating odor arose.

Then came a deluge of birds of all kinds which feasted upon the bodies of the dead rodents, a cloud of winged scavengers, which, unaffected by the poison, ate at will of the dead mice which covered the ground for miles.

Mice Kill a Sheep

As the war on the rodents began to have its effect, weird tales began to circulate—tales too strange to be believed at first, but which were later verified.

One concerned the death of a sheep which was in the path of the advancing horde of mice. Penned in a small inclosure, it was unable to escape, and the mice swarmed over it, pulled it down and stripped its bones of flesh.

In another instance, where a granary was concerned, a group of men killed 22,000 of the pests within the inclosure in one day. "Mice proof" granaries were built without avail. The mice gnawed through the wooden barriers, through the sacks and devoured the stored grain at leisure.

Ranchers of the district found the mice in their clothes, in their bedding and in their stores—even shook them out of their shoes when they dressed in the morning. What few women resided in the infested district fled as from a pestilence.

As the poisoning campaign began to tell, the

authorities turned their attention to the source, the lake-bed, which for several years has been dry and has been farmed in grain, thereby making mice food plentiful.

Here, Mr. Piper and Whit C. Barbour, Kern County Horticultural Commissioner, found, in spite of the millions which had migrated, literally millions more, ranging from 400 to 4,000 to the acre, or about one mouse for every man, woman and child in the United States.

After appearing before the Kern County Board of Supervisors and obtaining an emergency appropriation for the war on mice, another campaign was agreed upon, this time poisoned alfalfa and grain being used. It is estimated that 5,000 dollars will be needed during the next three years to clear the lake-bed of the pests.

If poisoned grain and alfalfa proves too slow, poison gas may be used, as suggested by General Amos Fries, Chief of the Chemical Warfare Service of the United States Army. General Fries declared that chlorine gas could be obtained for the work from army posts of the west and that the gas would kill all mice found on or near the ground.

The infested area is, roughly, nine miles wide by 12 miles long and does not include any stock ranches or farms. Therefore gas could be used without endangering lives of stock or people.

HOW THE MICE ATTACKED GRAIN

The army of mice stopped at nothing short of poison. Note how they destroyed these grain sacks

Must Be Exterminated at Source

Several interesting theories have been advanced to account for the migration from the lake-bed. The one most widely accepted by residents of the district is that, as this has been a wet year, the mice have been driven from the lake-bed by rising ground water. This is discounted, however, by the large number of mice still found in the lake-bed. The enormous number of the pests has been accounted for by the fact that, for the past three years, the lake has been dry, food plentiful and weather conditions ideal for reproduction.

Another theory is that the mice, emulating their big brothers, the rats, have sensed a coming flood, and are leaving the lake-bed just as, superstition has it, rats leave a sinking ship.

Those who have no reasonable theory at all, point merely to invasions of grasshoppers and locusts in the middle west and shake their heads.

Three kinds of mice, the ordinary house mouse which originated in India and is now common all over the world; the field mouse which is larger; and the meadow mouse which is as large as a small rat, are included in the millions which have left and those which still infest the district.

Actual damage has been hard to figure, except in cases where large stores of grain and supplies have been invaded or seed grain dug out of the ground, but it has been estimated at 10,000 dollars.

It is not the damage, however, which has attracted the attention of scientists and authorities of the country, but the staggering number of the rodents which have swarmed over the country.

Under normal conditions, it is estimated that a healthy mouse (and those found in Kern County appear to be healthy) will produce a family of six every three months, so that the total result over a period of years would be amazing.

Mr. Piper, in outlining the situation to the Kern County supervisors during the campaign, following a preliminary survey said:

"Such manifestations usually continue for two or three years before they die out. My survey disclosed that mice are still abundant in the dry lake-bed. The infestation is spotted, in some areas the mice running as high as 4,000 to the acre and in others as low as 400 to the acre.

"In the grain stubble about the lake-bed, the mice seem to be dying off somewhat, but where green stuff is growing they are thriving and multiplying rapidly. It is quite possible that the mice may be able to keep up their numbers and that you can expect another invasion.

"The problem now is to exterminate the mice at their source. Poison grain will still be used, but poisoned alfalfa is cheaper. The plan is to poison all the land in the basin—about 30,000 acres."

One interesting sidelight on the situation was that which concerned cats. One would suppose that the invasion would have created a regular cat heaven, yet it was reported that after the first few days during which all of the cats of the neighborhood gorged themselves on choice mice, they refused to touch any more, literally turning up their noses at them.

Other States Liable to Invasion

One nearby city offered to gather up all the stray cats of the district, some 300, but the plan was abandoned when it was figured that even 300 cats would make little headway with millions of mice, especially if the cats, after glutting themselves for a day or two, refused to do any further exterminating.

It is interesting to note that California does not have a monopoly on the possibility of mouse plagues. According to Vernon Bailey, of the United States Biological Survey, there are 38 states in this country that are liable to mouse invasions. Only those states on the Gulf of Mexico, and Kentucky, Oklahoma, Arkansas and Tennessee are exempt. In all others, precautions should be taken to prevent occurrences like that described above. Since the total increase from a single pair of mice will, in one year, reach over 1,000,000, if all of the progeny live, it is obvious that the little animals do not need much encouragement to cause them to overrun the country-side.

Mr. Bailey recommends that, in order to reduce the chances of the mice breeding and multiplying rapidly, farmers keep all ditches, fields and field borders cleared of growths. This will give the natural enemies of the mice a chance to see and catch them. Among these enemies may be numbered the owls, hawks, gulls and herons, all of which enjoy delectable mice as at least a large part of their diet.

WAR TO THE LAST DITCH!

This is part of the 50 miles of trenches that were dug and lined with poisoned grain as bait for the mice. Dead mice line the trenches at the rate of 85,000 to the mile

PART OF THE CONQUERED ENEMY

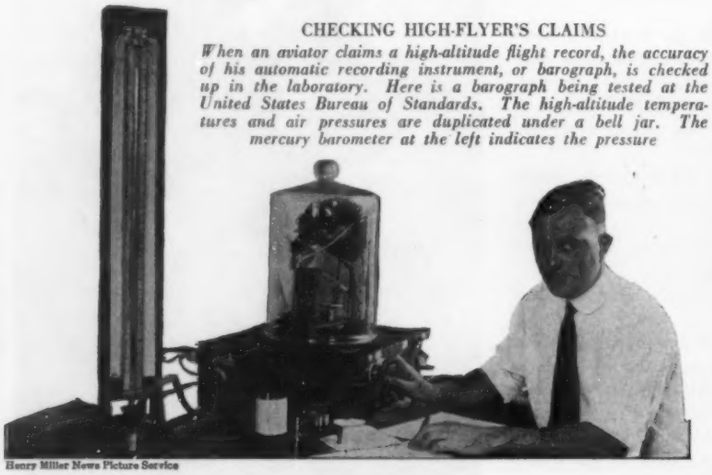
One of the thousands of piles of dead mice that died in the vigorous war waged against them. It is estimated that over 5,000,000 mice were killed by means of poison

From the Scrap-book of Science—Came

Underwood & Underwood

EAR PHONE FOR THE VERY DEAF

For those whose hearing is nearly gone, Dr. Charles W. Harper of New York has invented this large, non-portable earphone. It cannot make the totally deaf hear



Henry Miller News Picture Service

CHECKING HIGH-FLYER'S CLAIMS

When an aviator claims a high-altitude flight record, the accuracy of his automatic recording instrument, or barograph, is checked up in the laboratory. Here is a barograph being tested at the United States Bureau of Standards. The high-altitude temperatures and air pressures are duplicated under a bell jar. The mercury barometer at the left indicates the pressure

Ewing Galloway

NEW 4,500,000 DOLLAR UNITED STATES

A vehicular and pedestrian bridge is being erected ove With the approaches, it will be a mile long and will spans. The contract calls for 10,000

Wide World

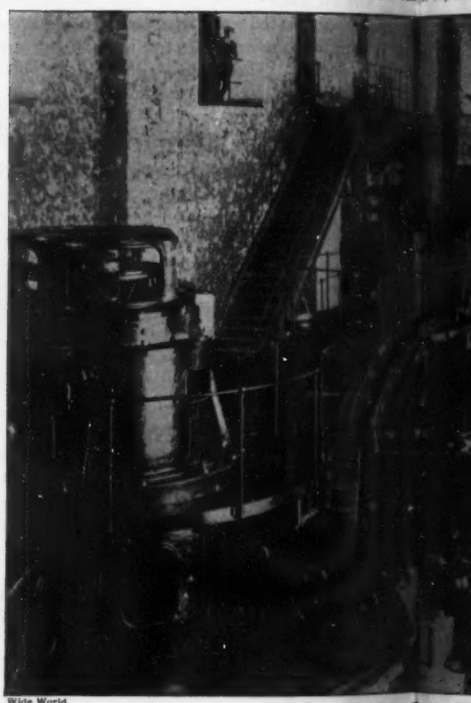
NEW DEVICE AIDS SCULPTORS

This apparatus makes accurate stereoscopic "maps" of the human figure, exactly as stereoscopic relief-maps of landscapes are made. A special camera on a swinging arm takes contour pictures (note sharp border of illumination) from all angles. When combined, these reproduce the three-dimension effect of a solid

Science Service

THOUSAND-YEAR-OLD BEAD TREASURE

Dr. A. V. Kidder, anthropologist, at the National Research Council, Washington, displays a 48-foot string of beads from the grave of a prehistoric medicine man. The 5,700 beads were found by Dr. Kidder, the discovery being made at Pecos Pueblo, New Mexico



Wide World

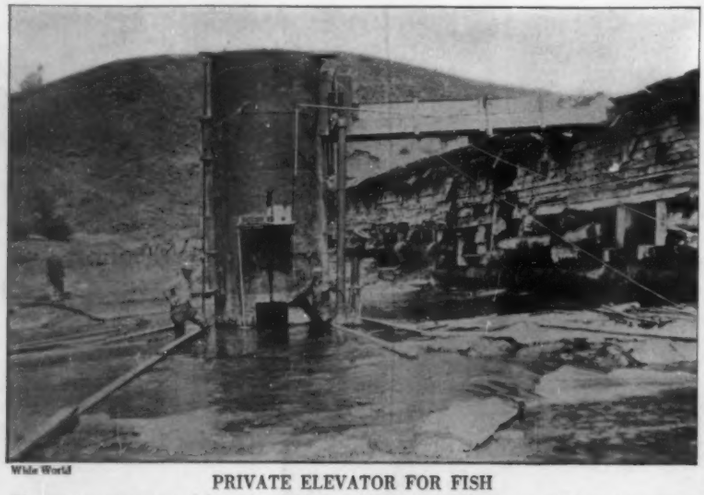
FRANCE TURNS T WHITE

Since the World War, much of the coal which man bought from England has been supplanted by white c the Continent. Here is a battery of new hydroelectric energy of the Rive rease to

Wide World

MINIATURE ARTILLERY RANGE

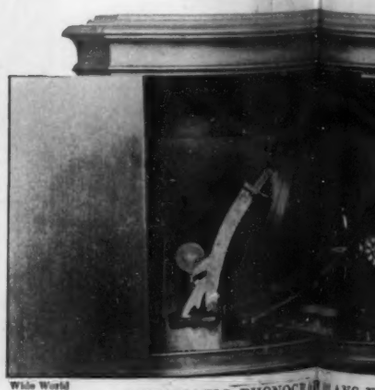
At Princeton, when the student-officer viewing this map model through field glasses, gives firing data and the command to fire, smoke appears at the designated point



Wide World

PRIVATE ELEVATOR FOR FISH

The instinct of certain fish, such as salmon, drives them annually to climb to the sources of surging streams to spawn. But man's power-dams often balk the fish, hence they do not spawn. Here is a fish elevator automatically operated by the water. It permits the fish to "climb the stairs" and so reach the upper level of water



Wide World

AUTOMATIC PHONOGRAPH PLAYS F

A well-known manufacturer has perfected apparatus wh records, one by one, through a phonograph. Thus an e program of dance music can be started entirely forgo form the necessary operation of taking the disk off

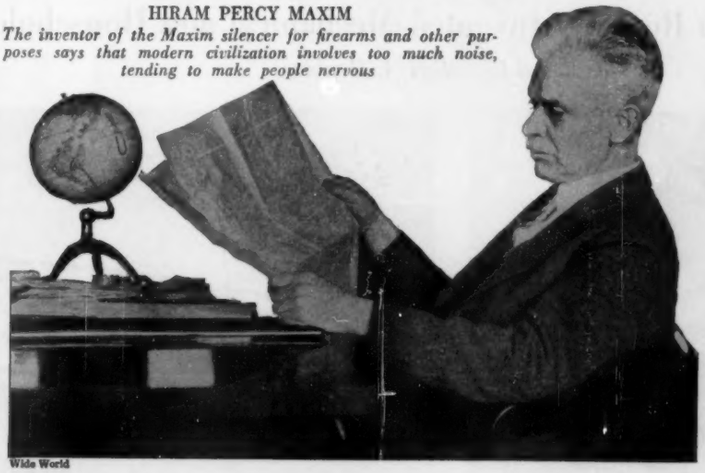
-Camera Shots of Scientific Happenings

AR UNITED STATES-CANADA BRIDGE

ge is being erected over the Niagara River at Buffalo. e a mile long and will be made up of five separate ontract calls for 10,000 tons of steel

HIRAM PERCY MAXIM

The inventor of the Maxim silencer for firearms and other purposes says that modern civilization involves too much noise, tending to make people nervous

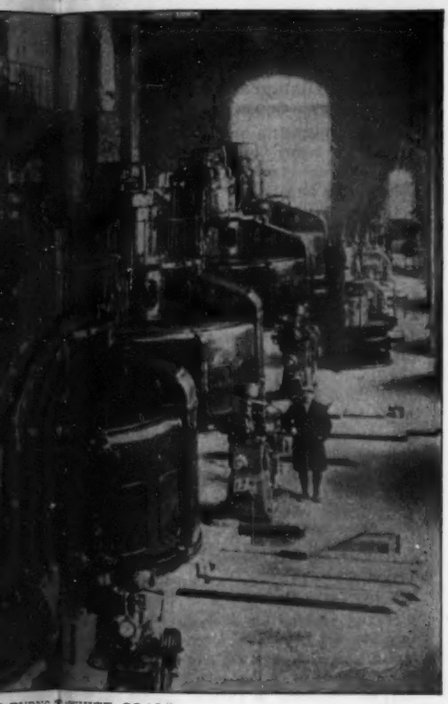


Wide World

Jacques Boyer

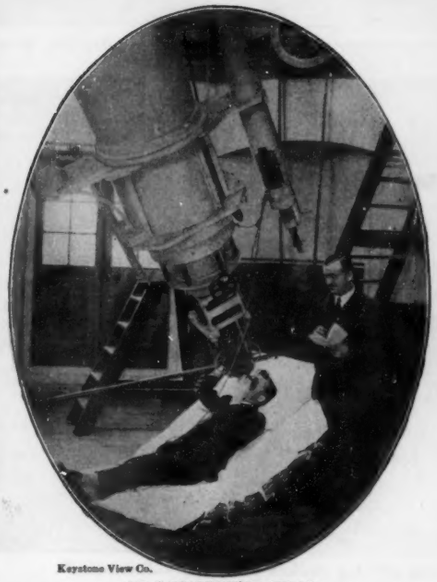
ACETYLENE RUNS FLIVVER

Monsieur Jacquelin has equipped a Ford car with an acetylene generator. With certain engine alterations, this fuel can be used in any internal-combustion engine



E TURNS TO "WHITE COAL"

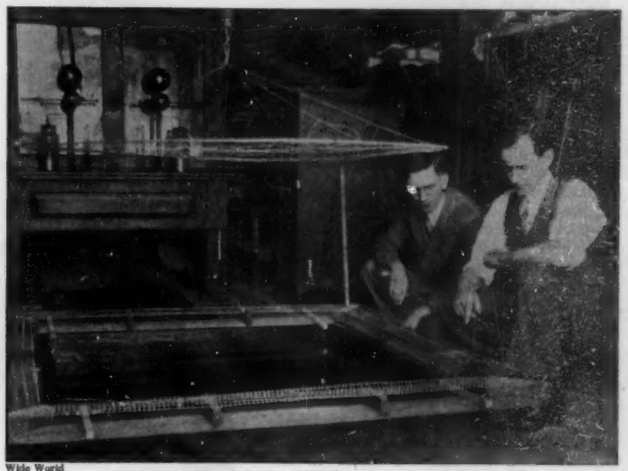
of the coal which many European nations formerly supplanted "white coal" generated by the rivers of ry of new hydroelectric generators which will send the of the Rivers Romanche to Paris



Keystone View Co.

AT LONGITUDE ZERO

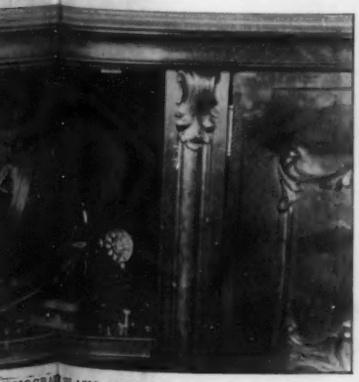
At the famous old Greenwich Observatory, England, the zero point of world longitudes, astronomers use an adjustable feather bed while making visual observations. However, an astronomer's life is no bed of roses, for observatories cannot be heated in winter



Wide World

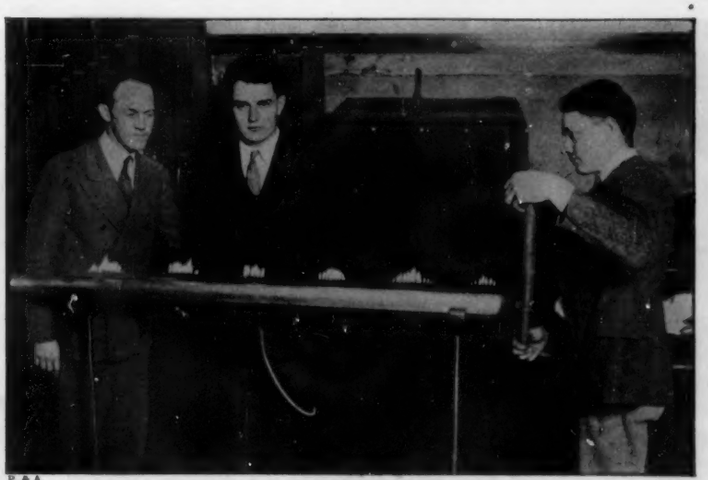
NEW SYSTEM OF LIGHTNING PROTECTION

The Pan American Petroleum Company has adopted the cage system of lightning protection for its storage reservoirs—the largest in the world. This model reservoir has a cordon of wire which, according to the company's engineer, collects the ground potential and dissipates it to clouds by slow ionic discharge



ONOGRAPH PLAYS FOR AN HOUR

perfected apparatus which automatically runs several phonograph records an entire symphony or an assorted started automatically forgotten until finished. Cams per- on of substituting the disk off and putting on the next



P. & A.

SENSITIVE FLAMES EXPLORE SOUND WAVES

Students at Pomona College, California, performing Professor John Tyndall's famous flame experiment with sound. In his classic book entitled "Sound," Tyndall describes this experiment which shows the node positions in continuous sound waves. At the nodes, the flames burn low; at the loops between nodes the flames are excited

Kodel & Herbert

COFFEE GROWN IN FLORIDA

H. W. Johnston, a citrus fruit grower of Homestead, near Miami, makes a hobby of growing exotic plants. He grew this coffee plant from seeds imported from Arabia

Novel Devices for the Shop and the Home

A Department Devoted to Recently Invented Mechanical and Household Appliances

Conducted by Albert A. Hopkins

Carrying the boat on the running board

The collapsible boat with an outboard motor

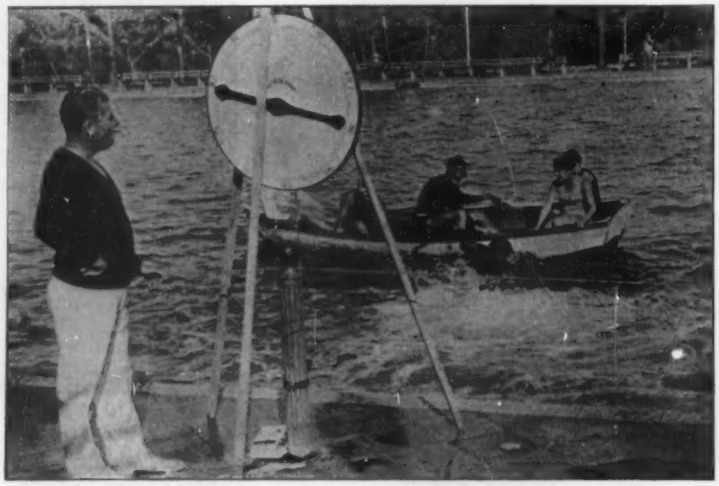
A Real Folding Boat

UNLIKE many similar types of craft, the folding boat shown in two upper illustrations on this page is a real boat in every way. It is sturdy, strong and practical, even in rough water. It can be carried with ease on the running board of an automobile and is quickly assembled without the aid of tools of any kind. The sides and bottom are of sectional lattice-work held in place by clamps. The frame itself is made of seasoned ash, with truss construction and is fastened together with a turnbuckle device. When the canvas cover is secured to the frame by means of two cables fastened on either side and forming a two-inch gunwale, it is waterproof as well as reasonably puncture-proof. Movable seats with adjustable oar-locks are provided. The boat is equipped for mounting an outboard motor in the manner illustrated.

Jelly Time Will Soon Be Here

THE jelly and puree strainer shown in the illustration directly below is made of aluminum and is used with a small wooden pestle. It strains any fruit pulp, soup or sauce and makes it of a pleasing smoothness. The strainer fits into a three-legged stand of bent wire which may be conveniently placed on the kitchen table. The device is valuable for making jelly, marmalade, applesauce, et cetera. There are no movable parts to get out of order. The shape makes it the metal duplicate of a jelly-bag but its construction renders it much more durable.

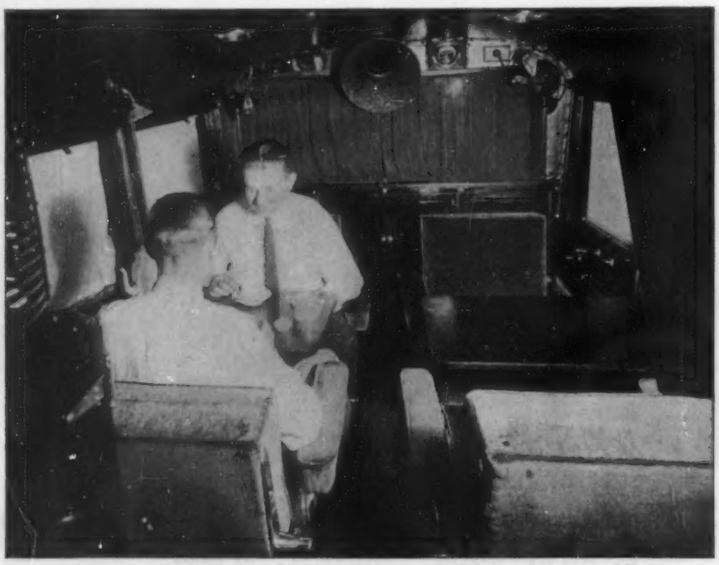
Jelly strainer in use



Testing a swimmer's arm and leg strokes with the "swimometer"

Registering Swimmer's Strength

PACIFIC COAST swimmers have adopted a novel "swimometer," invented by Ray Alexander of San Francisco, to test their strength of arm and leg strokes when swimming. The machine is mounted on a tripod and registers up to 100 pounds. A line is attached to the swimmer, allowing plenty of room for freedom of action. The illustration in the center of this page shows the "swimometer" registering an 80-pound pull at the beginning of a left-arm stroke.



Communicating with the driver by means of the "dictagraph"

The "Dictagraph" Awheel

THAT useful little device, the "dictagraph," pops up in all out-of-the-way places. The center illustration at the bottom of this page shows one installed so that occupants of the motor bus can give directions to the driver without the necessity of using speaking tubes.

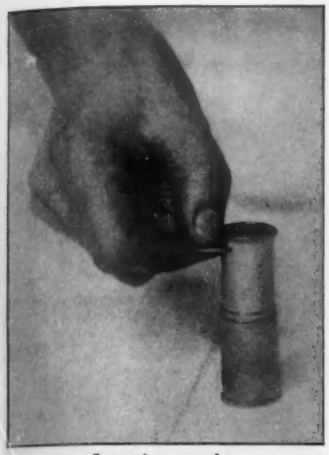
Novel Telephone Booth

HEREAFTER, the harassed public, seeking the use of a public telephone station, may phone in privacy without the attendant discomforts of ordinary booths. The illustration at the bottom of this page shows the new booth. It has several features in its favor, among them being that it is more attractive and harmonizes more readily with its surroundings; it is also air-cooled. As can be seen by the picture, only the upper part of the patron's body is enclosed in the booth. An oval window admits light.

Bakeries Increase Production

COMMERCIAL bakeries produced 1,267,857,169 dollars worth of bread, cakes, pies and pastries in 1925, which was an increase, the Commerce Department reports, over 1923. The gain was made despite a 5.6 percent decrease in the number of bakeries —17,681 reporting in 1925 as against 18,739 two years previous.

This 'phone booth is cool



Inserting a coin

Telescoping Bank

THE thin dime is not what it used to be when its buying power is considered, but even at that it can at least be used to build up dollars as of yore. As an aid to this end, we have the efficient bank shown in our illustrations at the top of this page. The bank holds five dollars in dimes, yet can be telescoped to an inch in length. The bank is locked with a key. When the latter is removed, the bank is securely fastened.

Air pad for crutch

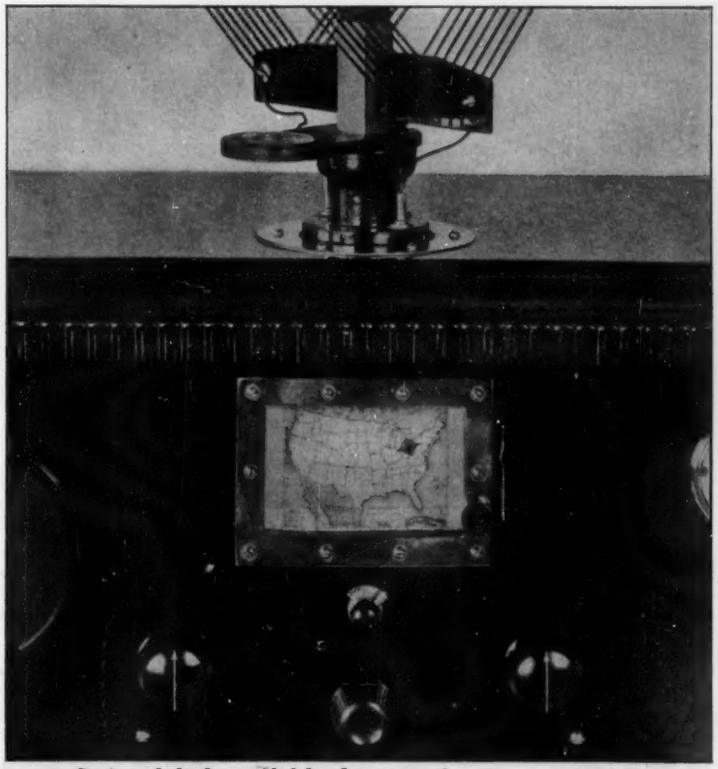
Direction Indicator for Radio Loop-Aerials

A NEW invention for radio loop-aerials eliminates the guess work. An indicator mounted on a map is swung into line with the station to be received and the loop is set automatically. The device makes possible exact loop setting for maximum selectivity and signal strength. A map of the United States is mounted on the panel under glass. On this is placed an arrow indicator. Loop and indicator are synchronized by a magnetic compass.

Air Pad for Crutches

WE illustrate on this page something new in crutches. There is now available a crutch pad which is filled with just enough air to make it comfortable to the user. The pad is laced to the under-arm piece and is held securely. In connection with its manufacture, there is an interesting fact. One wonders how the air is injected without a valve. The puzzle is solved by the use of a hypodermic needle which is inserted while the rubber fabric is still a little warm. It is slowly pulled out, whereupon a slight blow with the hand over the point of insertion seals the hole effectually.

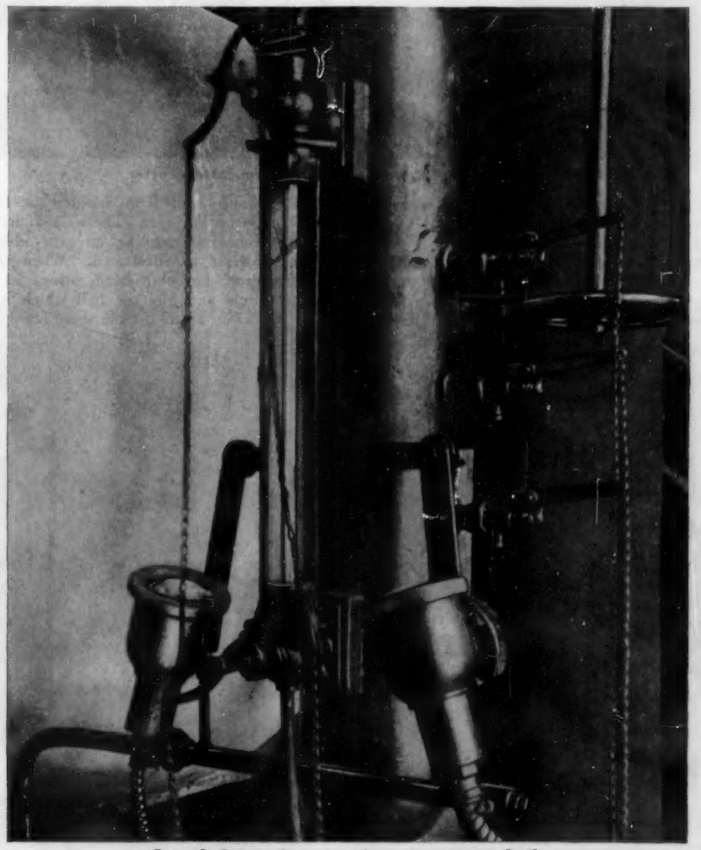
The crutch pad in use



Setting of the loop aided by the map and a magnetic compass

Light-weight Rubbers

THE new shoe-protectors shown in our illustration are so light that they are easily rolled into a small case and carried in the average shopping bag. Rolling them does not injure the rubber as it is only the thickness of the leather used in a kid glove.



Cross-lighting the gage-glass on a steam boiler

Collapsing the bank

Lighting the Gage-Glass

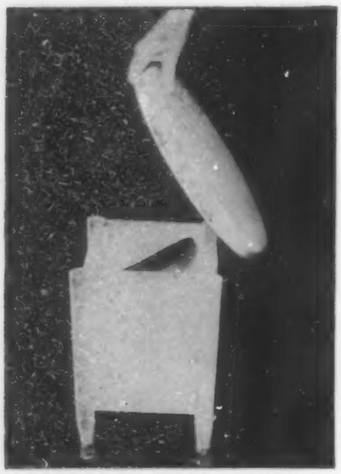
IN the dimly-lighted boiler room it is often difficult to see the level of the water in the gage-glass. The device shown in the center illustration at the bottom of this page enables the boiler-room crew to see the exact level at any time and from all parts of the operating aisle. The gage-glass is illuminated by two directed light-sources. The total reflection of the directed light-beams from the meniscus at the water level gives the desired information. A lens is placed in the holder in front of a 50-watt lamp.

Light-weight, foldable rubbers

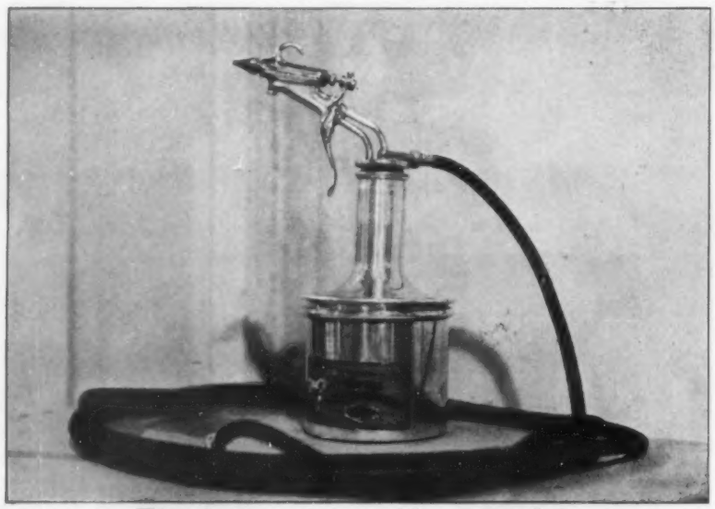
Safety Flat-Iron Holder

OUR lower right-hand illustration shows a flat-iron holder for ironing boards. It is designed to prevent the flat-iron from falling on the floor, with possible injury to itself or people in the vicinity. It will also tend to prevent fire. The holder consists of a sheet of asbestos surrounded by a metal rail and is permanently attached to the board. This flat-iron holder will be a great convenience in any household.

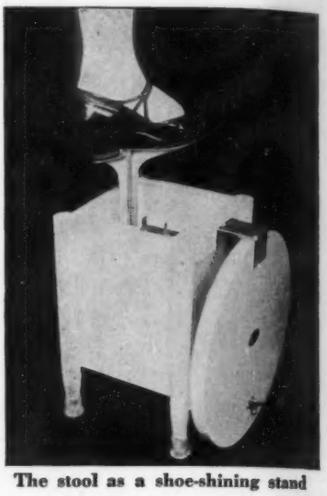
Safety for the flat-iron



Tilting the lid of the stool



This paint sprayer is operated by compressed air



The stool as a shoe-shining stand

A Handy Paint Sprayer

THE device which we show in our illustration in the center of the top of this page is extremely portable and can be used to do painting with or without the aid of a spray booth. It has a nozzle control for working with a line from one-quarter of an inch wide to seven inches wide. Aside from a large variety of painting and varnishing jobs, it can be profitably used to clean motors with kerosene. Compressed air is

A steam generator for the tailor

used for ejecting the liquid contained in the bottle.

Wrinkles Removed by Steam Heat

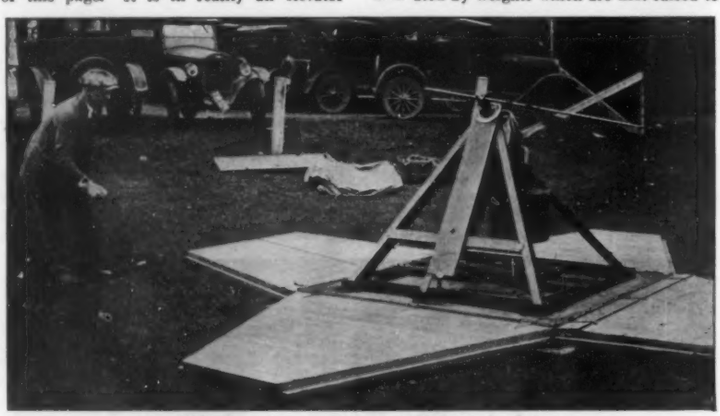
A NEW device which takes wrinkles out of garments is manufactured by a San Francisco firm. This machine, shown in our illustration in this column, consists of an electric steam-boiler connected to a sad-iron through flexible tubing. Steam is generated in the boiler by means of a General Electric two-kilowatt immersion heater.

Truck Loader Operated from Engine

AN interesting truck-loading device is shown in the illustrations at the bottom of this page. It is in reality an elevator operated from an hydraulic cylinder, which in turn is energized by the truck's engine. The elevator is designed to lift a loaded hand-truck from the ground or floor level to the level of the truck body, thereby greatly facilitating loading or unloading operations. When not in use as an elevator, the device becomes an end-gate as shown. The elevator is raised and lowered by means of cables which pass up over sheaves and then are connected with the piston of the hydraulic cylinder.

Flight, "Click" and Cover Durability Tested Mechanically

A MACHINE for testing golf balls is operated by weights which are first raised to a set distance and then released at the proper time by a trigger. The weights actuate a mechanism carrying an arm which holds a driver as illustrated. When the weights drop, the club head swings in a perfect circle and hits the ball which has been placed on an adjustable tee. The ball is always hit fairly and the impact of the club head momentarily distorts the ball to an amount equal to 40 percent of its normal diameter. As the ball reacts, it starts on its flight at the rate of 250 feet a second. By changing the weights and the position of the tee, the driving range can be varied from the maximum distance of 250 yards to about 200 yards.



A golf-ball testing machine which reveals defects

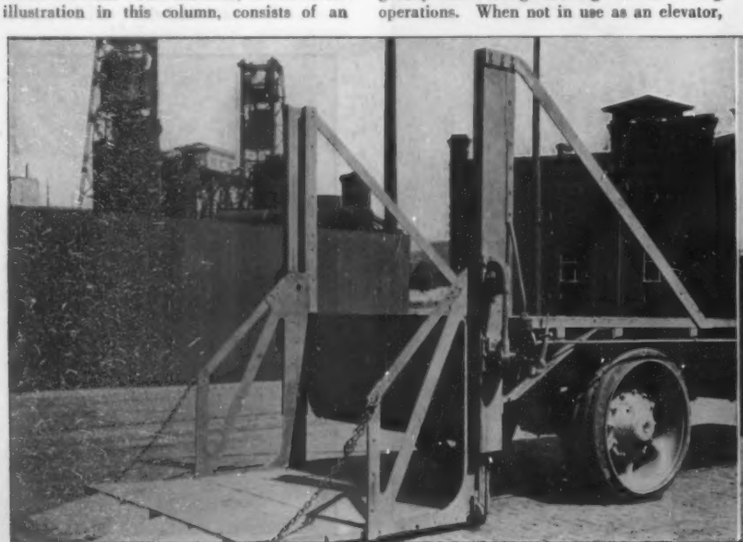
Combined Shoe-Shining Stand and Bath Stool

BY tilting the lid and lifting the foot-rest within the bath stool shown in our illustrations at the top of this page, a shoe-shining stand is formed. A light touch is all that is required to cause the shoe-rest to sink back into place within the stool.

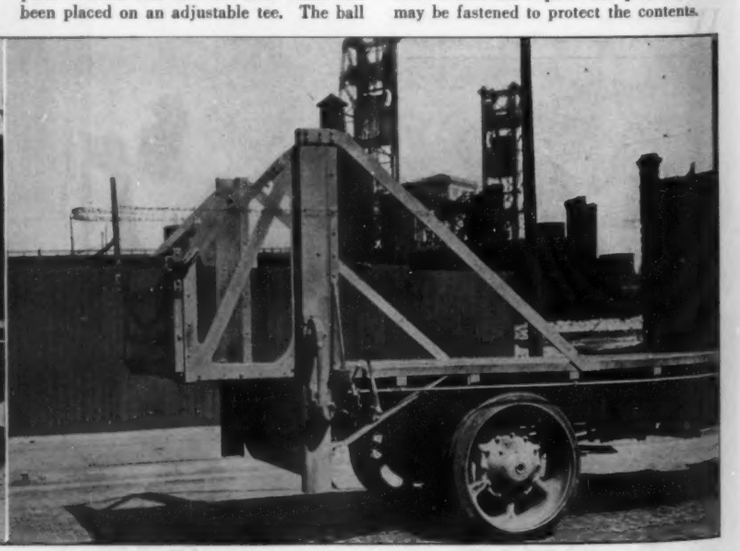
Fishing tackle in a hat band

Hat Band Carries Fishing Tackle

THE first aid to the fisherman shown in the photograph directly above is very convenient for carrying fishing tackle when the sportsman is not wearing a coat. It consists of a series of leather pouches that fits around the crown of the hat. An elastic band holds it in place. The hooks and other tackle are kept in the pockets, which may be fastened to protect the contents.



Preparing to raise the elevator from the ground



When raised, the elevator becomes an end gate

Novel dumb-bell for golfers

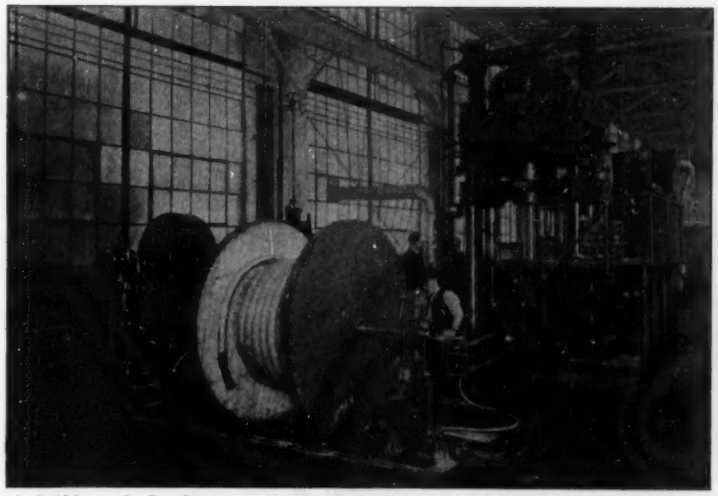
The Golf-Leverage Dumb-bell

THIS ingenious device—the invention of P. A. Vaile, an authority on golf and tennis—strengthens the "grip" by specially exercising the muscles of the hands and forearms. The angular placement of the portion to be grasped conforms to the formation of the hand and throws the weight squarely across the line of the forearm. Any relaxation of the grip, except when the arms are held downwards, results in an overbalancing of the dumbbell, causing it to fall out of line and hit the arm. In class-formation exercises, any laxity of grip is immediately seen by the instructor on account of this peculiarity.

Keeps Food Warm

THE thermo cover and plate combination illustrated on this page has a lightweight cover which, when in use, rests on the edge of the plate. The chef can seal the food hermetically in the kitchen, thus preserving it warm and moist until it is to be served. Waiters do not need to take off the cover as it is light in weight and easy to remove. The handles are away from the body and therefore are always cool. When the cover is removed, it is turned back, resting on its edge near the plate, so that it does not take up much room on the table. The combination is constructed with a minimum inside air capacity so that the contents can be kept warm and moist for a long period. The construction also permits of superimposing, and the waiter can easily carry six or more combinations at a time.

Hotel operators and club managers have spent large sums of money on kitchen appliances for improving their service, and although modern and expensive equipments are installed for cooking, the art of serving and preserving food after it is cooked still remains a problem. The skill of any good cook is not recognized if the method of serving does not do justice to his ability. Food that is properly cooked but not efficiently served does not always retain its savor.



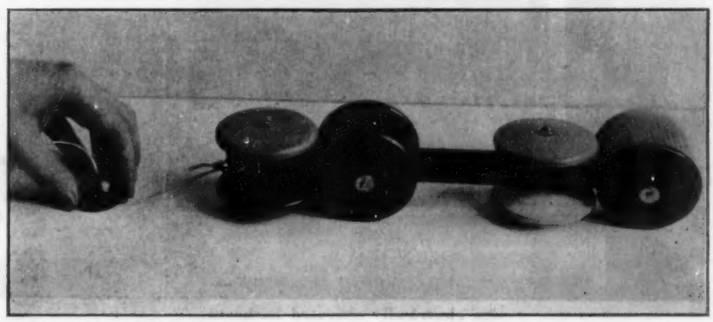
A 2,600-ton hydraulic press for lead sheathing electrical cable. It requires a very powerful pump to supply the proper pressure

A Toy That Cannot Be Upset

THE toy which we illustrate in the center of this page is non-capsizable. It stands all kinds of abuse and can be rolled on any side. It is ten and one-half inches long and the wheels are two and one-quarter inches in diameter. The toy is very attractive, being enameled in eight colors. It is known as "Follow-Me Tinker," the trade name of the manufacturer being "Tinker."

Auto-Crib Takes Little Room

OUR lower illustrations show an auto-crib that can be folded flat against the back of the front seat. In this position, its pockets can be used for holding various articles. The crib fabric-covering is detachable and can be laundered. It can be taken from the car, set up in the home and used as a bassinet. It can also be swung from the railing of a porch. In case of stopping over night at a hotel when there is no bed provided for the baby, this crib can be hung from the head of a bed after removing the pillows from their regular positions and placing them at the bottom of the bed to accommodate the parents. In other words, the bed is made up so that the parents' heads will be toward the foot of the bed.



This toy car can still be pulled after it is upset

This device will keep food warm for a long period

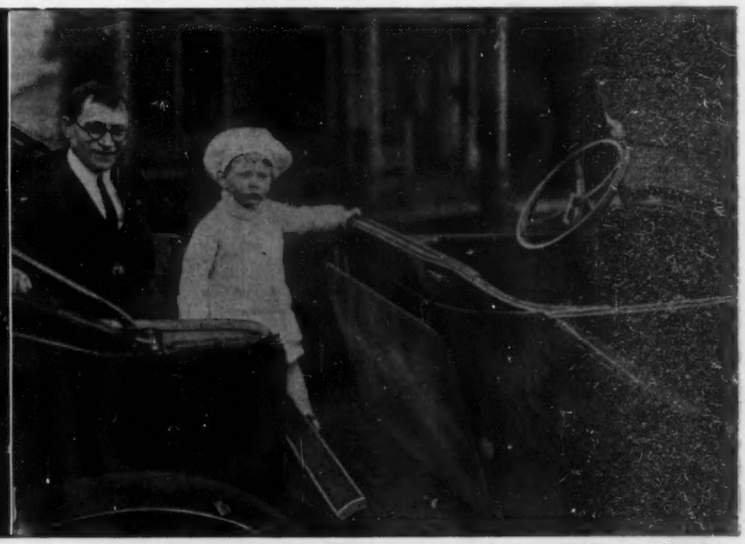
A Mammoth Hydraulic Press

THE photograph at the top of the page shows a 2,600-ton hydraulic press for lead sheathing cable at the Schenectady plant of the General Electric Company. It is the largest hydraulic press for this work in operation in this country. The press operates at pressures as high as 7,000 pounds per square inch on the water. A specially designed pump is required to secure these high pressures and the quantity of water necessary. This press is one of the machines which is merely shown to visitors.

Dike for the Zuyder Zee

THE Dutch Government has concluded an agreement with a contracting company for the construction and the upkeep until completion of a dike which will separate the Zuyder Zee from the North Sea and which will be 19 miles long, according to Commercial Attache J. F. Van Wickel, The Hague, Netherlands. The cost of this dike is estimated in the budget at 80,000,000 florins. (The florin is now worth about 40 cents.)

Baby's crib is swung from the top of the automobile



The crib can be placed out of the way when not in use

Banjo-ukulele in use

Folding Banjo-Ukulele

A NEW YORK manufacturer of musical instruments has recently introduced a novel collapsible banjo-ukulele. The ordinary banjo-ukulele measures 21 inches in length but this one, when folded, measures only nine inches from one end to the other.

Portable "Washing Machine"

WE illustrate at the top of this page a traveler's emergency "washing machine" which will fit in an ordinary suit-

The instrument folded up

case. The handle is removable for more convenient packing. The device is, in reality, a double vacuum-cup similar to the cups used in large washing machines, but is to be operated by hand.

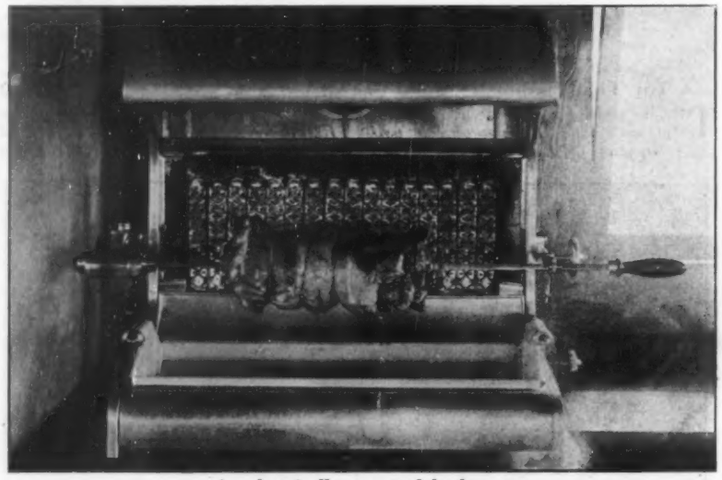
Electric Rotary Roaster

THE rotisserie shown in the middle of this page is a modern appliance for roasting foods in the manner that is commonly known as "barbecue cooking." It uses either gas or electricity for fuel and is equipped with an electric motor for rotating the spit. The major part of the machine is made of polished cast-aluminum which makes a very attractive appearance and insures absolute cleanliness.

A "washing machine" for the traveler

Steam Heat by Electricity

THE device illustrated at the right center of this page consists of a radiator which is not connected by steam pipes with a boiler or furnace. Instead, the steam is generated in the radiator itself by an electric steam-generating element within. This element obtains its current from a floor plug, the radiator beginning to radiate a warm, healthful heat within a few minutes after the button is pressed, reaching its maximum heat in about 20 minutes. It is equipped with a temperature control; high, medium or low heat being obtainable.



An electrically operated barbecue

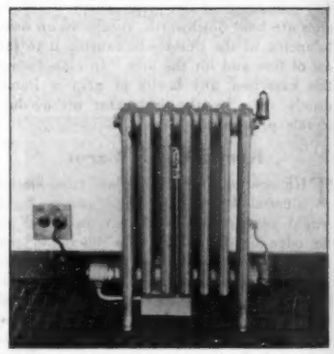
Helpful Hint to Motorists

THE illustrations at the bottom of the page show the ease with which a car equipped with balloon tires can be jacked up. Anyone who has undertaken to change a balloon tire on the road has usually experienced considerable difficulty in employing the ordinary jack furnished with the car. Much of this is due to the difficulty of placing the jack under the axle with the small road clearance available when a balloon tire is flat. It is also due to the extremely long lift that is necessary in order to raise the car high enough to remove the tire. By using the method illustrated in the photographs, the spare tire is first removed from the carrier and is placed directly ahead of the flat tire which is to be changed. The car is then driven slowly forward so that the flat tire rides up on the spare. In this raised position of the flat tire, it is quite easy to place the ordinary jack under the axle and very little effort is required to jack the wheel sufficiently higher so that the flat tire can be removed. The spare is then removed from under the wheel and placed in position for service.

Saves the ears from barber's shears

Safety in the Barber's Chair

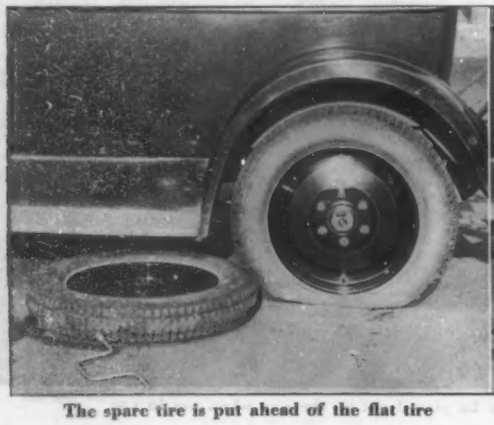
A NEW device, invented by a Denver barber and his wife, is designed to protect the ears of women and children while having their hair bobbed or marcelled. With the appliance properly put on, as shown at the top of this page, it is impossible to burn or cut the ear.



Electric steam heat

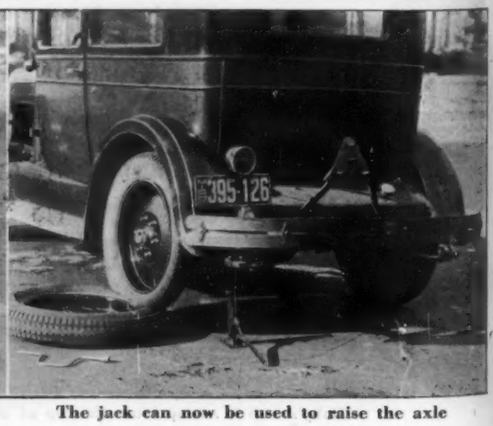
A New Ceramic Material

A NEW ceramic material related to porcelain that is not damaged by rapid temperature changes is said to have been developed by F. Behneke of Lübeck. The inventor states that the material can be heated to 700 degrees, Fahrenheit, and immediately immersed in cold water without cracking. It has been stated that it will be extensively used in electric heating devices.



The spare tire is put ahead of the flat tire

The flat tire rides up into place on the spare



The jack can now be used to raise the axle

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls

This Month's Cover Picture

THOSE whose scientific curiosity had been aroused by our rather unusual and bizarre cover illustration will find its purpose and its nature fully described in the following statement, prepared by the Nutrition Laboratory of the Carnegie Institution where the apparatus depicted was devised and is now in use:

"The apparatus is designed to measure the variations in carbon dioxide elimination as the result of food ingestion, changes in environmental temperature and humidity, and the effect of changes in amounts of clothing worn. It is perfectly comfortable and may be used for several hours without discomfort.

"The utilization of food substances in the human body results in the giving off of carbon dioxide to the air breathed out; also the absorption of oxygen from the air breathed in. The changes in the amounts of these two gases which occur after a meal may be large and rapid. To measure these changes a respiration apparatus is required in which the periods of observation are short (10 to 15 minutes).

"Usually the connection between the individual and the apparatus has been made with a mask, a rubber mouthpiece, or nose pieces. Any one of these is likely to result in abnormal breathing. This in turn affects particularly the giving off of carbonic dioxide. That is to say, a person may 'blow off' more carbon dioxide for a short period of time, than has actually been formed in his body.

"To promote free and natural breathing, Professor Francis G. Benedict, Director of the Nutrition Laboratory of the Carnegie Institution of Washington, Boston, Massachusetts, has devised a helmet," [which is shown on this month's front cover]. "The helmet is shaped like an ordinary tin pail. Over the open end is fastened a rubber diaphragm. In this diaphragm is cut a hole large enough so that it can be slipped over the head and yet will make a tight fit around the neck.

"At the left is a rotary air impeller which takes air from the room or from out of doors and drives it through absorbers. These absorbers remove the water vapor and carbon dioxide (two bottles on the left; the first filled with soda lime for absorbing water vapor, and the second nearest the person, filled with calcium chloride, for absorbing carbon dioxide). The air then enters at the top of the helmet and passes down over the head and face of the individual. Being dry it helps to keep the face cool by evaporating moisture from the skin.

"The air current, now containing water vapor and carbon dioxide, passes into a pressure equalizer consisting of a lady's bathing cap fastened over a pan. From here it is drawn away by means of a rotary air impeller shown on the right-hand table.

"The breathing can be seen by watching the bathing cap, and the ventilation can be regulated by adjusting rheostats connected with the electric motors on the rotary air impellers. The air current is driven by the right-hand air impeller through three bottles. The first of these bottles absorbs the water vapor. The next two provide for the absorption of carbon dioxide.

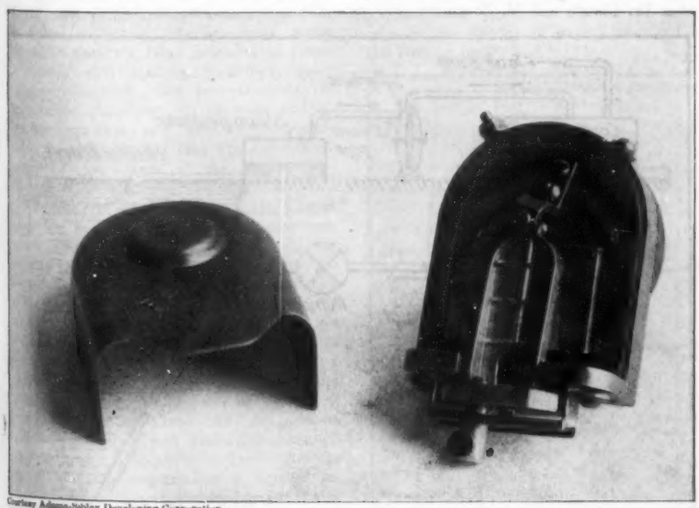
"The last two bottles on the right can be detached and weighed periodically. Their increase in weight indicates the amount of carbon dioxide given off in the breath during a measured period of time."

* * *

Capacity Type Pick-up for Phonographs

ALTHOUGH it has been said that the advent of radio has lessened the popularity of the phonograph, considerable work has been done in the past year or so on apparatus that permits combining, to their mutual advantage, these two sources of entertainment. Several electrical pick-up devices for converting the variations of the grooves of phonograph records into fluctuations of electrical currents have appeared on the market. These are designed to be used with standard radio amplifiers.

The latest comer in this group is illustrated in a photograph in these columns. This pick-up does not employ carbon granules or buttons, nor does it depend for the generation of a fluctuating current on the familiar electro-magnetic principle. Instead, it makes use of the fact that any variation of the spacing of the two plates of a condenser in an electrical circuit will change the capacity of that condenser and hence will alter the characteristics of the circuit.



Courtesy Adams-Sobley Developing Corporation

This new type of phonograph reproducer is to be used with a vacuum-tube amplifier. The ribbed, movable plate is made of aluminum

In brief, this pick-up consists of two small metal plates, one of copper and the other of aluminum. One of these plates is rigid while the other is connected to the needle holder. Because of the construction, any variation of the position of the needle as it is pushed from side to side by the irregularities of the record groove, will result in a change of the spacing between the plates of the condenser, and therefore will bring about a corresponding change in capacity.

When in use, this pick-up is to be connected in an oscillating vacuum-tube circuit in such a way that the variations of capacity of the device, as the phonograph record passes under the needle, will result in corresponding changes of the amplitude of the oscillations. In other words, the pick-up device, with the oscillating circuit, constitutes a miniature broadcasting station in which the constant-frequency current is modulated by changes in capacity. This modulated current is then fed to a standard radio-frequency amplifier, then to a detector where it is rectified, and finally to a well-designed audio-frequency amplifier.

* * *

Exercising the Ears of the Deaf

BY stimulating the ear with a kind of vibratory massage it has often been found that the hearing is improved. An apparatus has been perfected by means of which this kind of stimulation may be given simultaneously to groups of subjects.

The stimulative development of residual hearing is not particularly new, but modern instruments which will accomplish this purpose are of interest to those who are occupied in the education of the hard of hearing. It is estimated that 20 percent of the population is affected in some degree with defective hearing, although few are totally deaf.

It is well known that if the arm is injured and is carried in a sling for some weeks it becomes useless. The common treatment for this is massage and exercise; and vibration is found to be a valuable stimulant. The basic principle involved in the electrophone is that of applying a vibratory massage directly to the outer ear. If the delicately articulated bones and muscles of the middle ear have become rigid, this vibratory massage tends, it is claimed, to loosen them, strengthen the muscles, and aid nature.

International Newsreel

The electrophone in use in a famous New York institution for the deaf. It may be used to treat simultaneously a group of patients

* * *

The Steam-Diesel Engine

THE most highly efficient power-generating equipment so far designed is the Diesel-steam engine which combines in the same unit both steam and Diesel engines. Whereas the average internal combustion engine throws away a large portion of the energy of the fuel, in the form of heat radiated from its cylinders, in the steam-Diesel or "Still oil-steam" engine, much of this otherwise wasted heat-energy is recovered from the exhaust and cooling water of the Diesel portion and is used to generate steam. This steam is used, in turn, to generate power. The steam pistons and the Diesel pistons are, in fact, attached to the same piston rods. They work in unison, as the diagram shows.

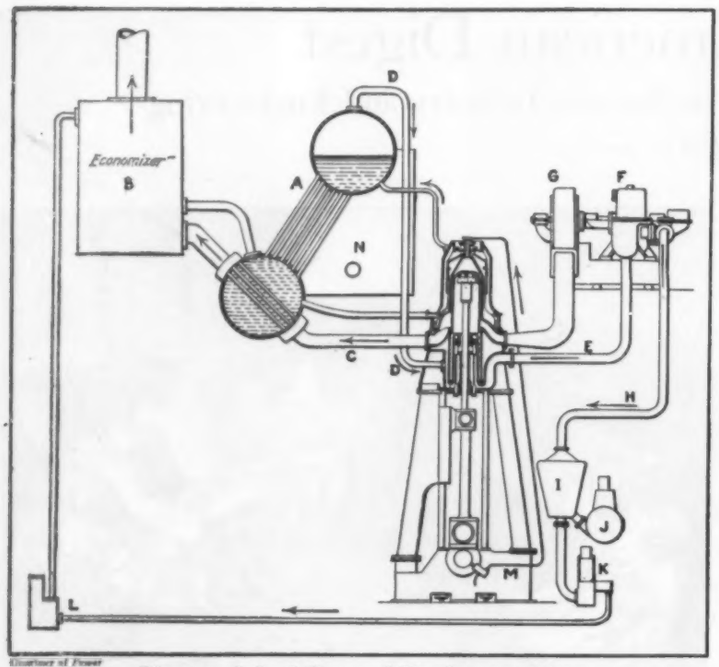
The steam-Diesel engine operates at an overall efficiency of as high as 38 percent. That is, it delivers to the driven shaft 38 percent of the latent energy of the fuel. As such things go, this is a very high efficiency.

A Diesel-steam engine of 2,500 horsepower, installed in the motorship *Dolmus*, is described in *Power* (New York) as follows:

"Each of the Scott-Still engines of the *Dolmus* has four two-stroke-cycle Diesel cylinders of 22-inch bore and a stroke of 36 inches. The lower ends of the cylinders are inclosed and are used as the steam portion of the unit. The steam-cylinder bore is the same as is the upper, or Diesel, end, but the effective piston-area is reduced by the piston rod by about 10 percent. The steam leaving the steam cylinder passes to a low-pressure turbine which drives the scavenging air blower. The engine's steam back-pressure is about 19-inch vacuum and the turbine exhausts into a 27-inch vacuum. About 14 percent of the total power output is delivered by the steam units. A diagrammatic outline of the Still system on the *Dolmus* is shown in the illustration.

"One special boiler *A*, consisting essentially of one-half of a Yarrow water-tube boiler, has its lower drum provided with a nest of tubes through which the exhaust gases from the oil engines pass. An economizer or pressure-closed heater *B* is interposed between the boiler and funnel. The engine jacket is connected to the boiler drums and is under the boiler pressure of 135 pounds and the boiler feed is drawn from the hotwell *K* by the pump *L* and delivered against boiler pressure into the economizer *B*, which in turn discharges into the lower boiler drum.

"The steam generated by the exhaust gases in the boiler and by the heat transfer

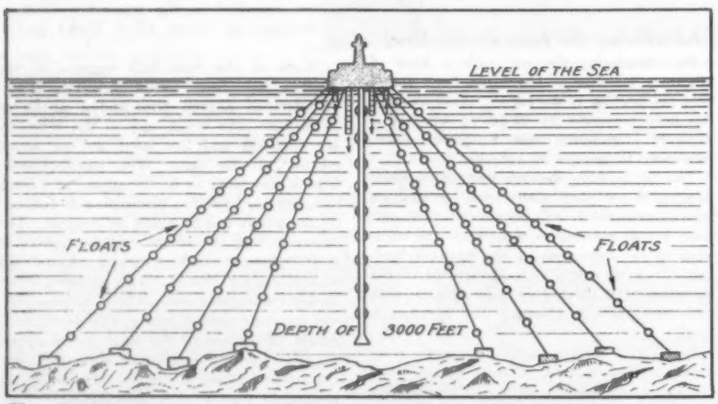


Courtesy of *Power*

Diagram of the Still type of Diesel-steam engine

in the cylinder jacket passes through the pipe *D* to the steam cylinder and exhausts through *E* to the turbine *F* which drives the blower *G*. In addition to the turbine, a motor, not shown, is coupled to the blower shaft. With a heavy load on the engine, the heat given up to the boiler is large and the steam cylinder's terminal pressure is high. This permits the turbine to drive the blower with the motor idling. With a low engine-load, the turbine's initial steam pressure is lower and the turbine slows down enough to cause the motor to assume part or almost all of the blower load.

"The oil for the Diesel end of the cylinders is handled on the solid-injection principle. The compression pressure is approximately 330 pounds per square inch. This might be too low for starting if it were not for the presence of the steam cylinder. In starting the engines, the oil burner *N* under the boiler is started and steam pressure raised. The warm piston and jacket so raises the cylinder air-temperature that the oil end fires on the first injection of fuel.



How the "floating power house" would be anchored. The long pipe extending downward is for the intake of cold water for the condenser

After development work is completed, the cost of installation should not greatly exceed that of the ordinary Diesel.

"About 14 percent of the engine's output is developed by the steam generated from the heat in the exhaust and in the jacket."

* * *

Inexhaustible Power from Sea Water—a Dream or a Prophecy?

THE newspapers have recently devoted so much space to the proposal of Dr. Georges Claude, French scientist, and his collaborator, M. Boucherot, noted electrical engineer, to generate immense amounts of power by evaporating warm water from the surface of the tropical seas, passing the steam through a power turbine and exhausting it into a condenser kept cool by a constant stream of icy water drawn up from the bottom of the sea through a deep conduit, that we are forced to describe the plan once more.

Sometimes we are accused of not keeping up with the times, when we have actually kept up with the times too well. The plan outlined above is a good case in point: it did not receive widespread popular attention in America until Dr. Claude visited this country last March. It was, however, mentioned in the Scientific American Digest last July. At that early date we stated our belief that the proposal was theoretically possible, but economically doubtful.

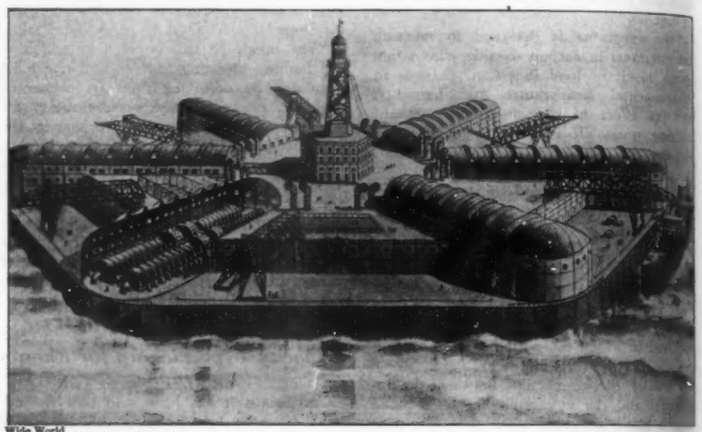
We now emphasize and amplify our opinion of last summer: we think that this most interesting proposal is theoretically and scientifically sound; also that the engineering difficulties, although great, are not insurmountable. But we do not think that, under existing conditions, power generated in this manner can compete *economically* with power generated from coal or falling water. In this we may do Dr. Claude an injustice.

In order to get at the essential "inwardness" of the "Claude-Boucherot" plan, we must forget or put aside our everyday experience which inclines us to the unconscious assumption that water boils only at a temperature of 212 degrees, Fahrenheit. On a stove, in an open tea-kettle at sea-level it is true that it does boil at that temperature, but under pressure, as in a steam boiler, for example, the boiling temperature is considerably raised; indeed, in the modern locomotive generating steam at about 250 pounds per square inch, the water will not vaporize until it has reached a temperature of about 400 degrees, while a few very modern stationary steam plants employ pressures so great that the water does not boil below 700 or 800 degrees, Fahrenheit, and the steam pipes are so hot that they glow red in the dark!

Now, just as raised pressures involve raised boiling temperatures, so do lowered pressures involve lowered boiling temperatures. Thus, on a mountain about 10,000 feet in altitude, the ordinary atmospheric pressure is only about 10 pounds per square inch, instead of 14½ as is the case at sea-level, and the boiling point of water is thereby lowered to about 190 degrees. That is why, in such a location, a pot of potatoes or beans has to be cooked almost all day—it is impossible to get the water hotter than about 190 degrees and this temperature does not cook things very rapidly.

What we have on the mountain top is really a *partial vacuum*. Therefore, in order to reduce the temperature at which sea water will turn into steam, it would seem reasonable and feasible to lower the atmospheric pressure still further—that is, to create still more of a vacuum, and this is what Dr. Claude and M. Boucherot plan to do in the tropics. By maintaining a vacuum by means of the condensing action brought about by the cooling due to icy water drawn up from the depths of the tropical seas, they will make it possible to turn immense volumes of warm surface-water, having a temperature of about 80 degrees, into steam. This steam will have a very low pressure—less than one-half pound per square inch.

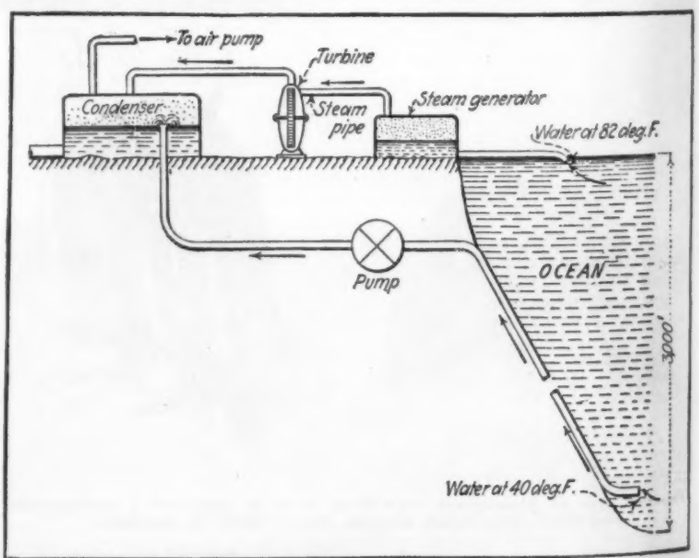
Thus the plan is utterly simple in principle. The difficulties, if any, would lie in the actual application. For example, it is found by one critic that the rotor of the steam turbine through which this low-pressure steam would pass would have to be very much larger in diameter than any such rotor in existence—perhaps 100 feet in diameter!



Wide World

Dr. Claude's "floating power house," to be anchored in water nearly one mile deep. The immense scale of size is suggested by the ship at the right. One of the large turbine units is depicted in one of the power houses, the roof being cut away to show it. What will such an installation cost?

Let us look at an imaginary installation of the Claude-Boucherot plan. One method suggested would be to build a kind of "floating island" and anchor it in the ocean. An artist's conception of such an island is shown in these columns. The entire plant would be installed on this island, a long cold-water pipe or conduit dropping straight down from the center towards the bottom of the sea. The warm water would be taken in directly from the sea around the "island." The other method suggested is to erect the plant near the seashore at some place where the water rapidly deepens, thus shortening the length of necessary intake pipe. Of the two plans we think the latter would be the more feasible; the former, the "floating



Reproduced from *Power*

Schematic layout of the Claude-Boucherot project. Starting at the upper right-hand part of the drawing, the cycle may be followed out: warm water is taken in, evaporates automatically at ordinary temperatures in a vacuum, the steam passes through a turbine, delivers its power there, and exhausts into a condenser which is cooled by cold water drawn from 3,000 feet beneath the surface of the sea. The cycle outlined above is continuous and silent

island" plan, would involve anchoring, in a mile of water, a great hexagonal vessel nearly half a mile in diameter. In our opinion, this vessel would be in constant trouble, due to storms and other natural forces.

But why so large an "island" or float? This brings up another important consideration, in fact we think it would be the most important consideration of all: the machinery installation necessary to generate the 160,000 kilowatts of energy (215,000 horsepower) would have to be immense because the steam pressure would be so low. Instead of 300 to 600 pounds per square inch, only one-half pound per square inch would be available. In other words, what is lost in pressure, must be made up in equipment, and we believe this provides the chief objection to the proposal.

How much power is available? For all practical purposes, all the power the human race needs. Heat is simply one form of energy. The water at the surface of the tropical seas is warm because it has absorbed heat from the sun which constantly radiates about 5,000 horsepower on every acre while shining. Some of this is taken up by the sea water.

It is a little difficult, perhaps, for us to realize how much energy is thus stored up in warm sea-water. We are more accustomed to associate large amounts of power or energy with bustling, throbbing, noisy, surging sensations. But here is energy in stupendous quantities, yet so quiet and inconspicuous that very few of the many scientific and technical men who have sailed over the sunny seas of the tropics have thought of it before.

The volumes of water which Dr. Claude and M. Boucherot propose to evaporate, some 35,000 cubic feet per second, are enough to make the average engineer, accustomed to evaporating water under radically different conditions, sit up and stare. Many a stream that is called a river does not deliver that great a volume of flow even in flood time, yet we must imagine such a stream of water (the intake pipe would probably be about 23 feet in diameter) constantly flowing into the evaporators, passing into vapor and passing on through the turbines. The problem would perhaps be difficult but nevertheless it figures out to be feasible from a thermodynamic point of view.

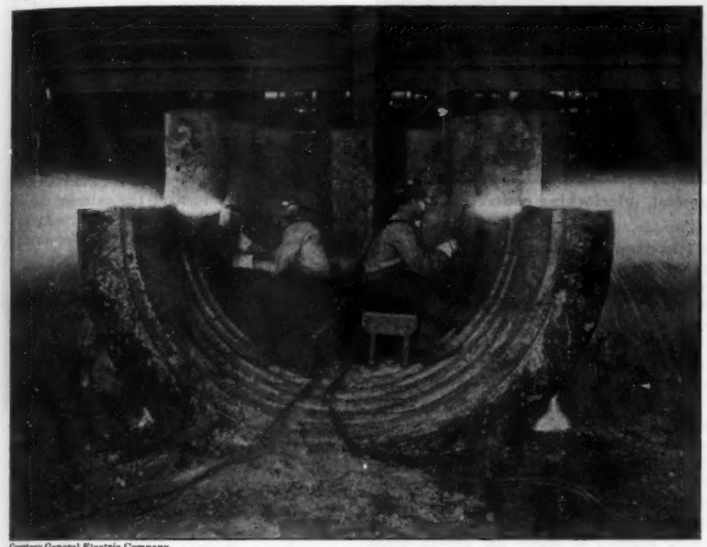
We have not "pooh-poohed" the Claude-Boucherot proposal, for Dr. Claude is the inventor of the well-known Claude method of nitrogen fixation. He is a scientist-engineer, not a poet, and his professional standing is high. Had this plan not appealed to our interest we should not have devoted space to it. It may ultimately turn out to be one of the those innumerable things which one generation of engineers calls "impossible," "ridiculous" or worse, and another generation performs.

The inventors plan to construct, on the banks of the River Seine in Paris, a small, 1,000 kilowatt plant, to be used as a demonstration and a large-scale test. The temperature differential will be obtained by using river water in winter, in combination with water artificially warmed in a boiler.

* * *

Cutting Steel with Illuminating Gas

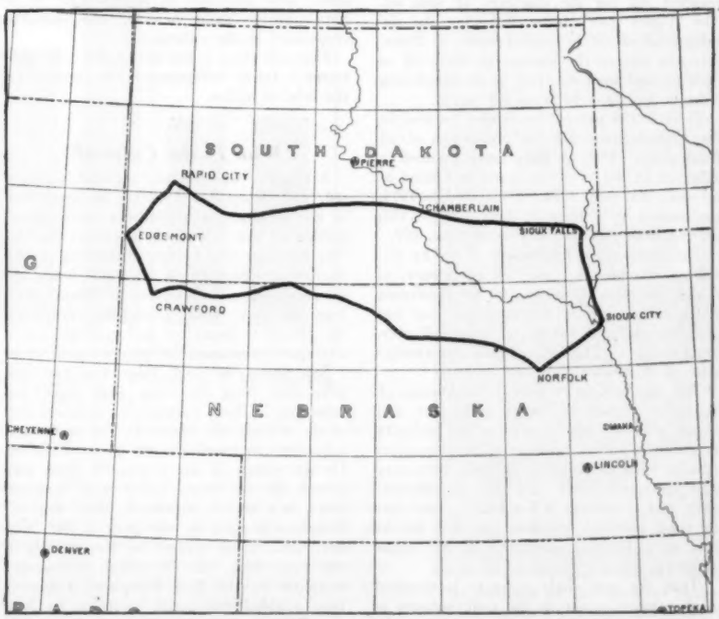
SINCE the adoption of illuminating gas to replace acetylene, hydrogen and other fuel gases in combination with oxygen for metal cutting, many valuable uses have been found for this new metal-cutting tool. The accompanying photograph shows two operators of the General Electric Company cutting risers from a steel casting with oxy-illuminating gas torches. By this method a 19-inch steel riser is cut through in seven and one-half minutes.



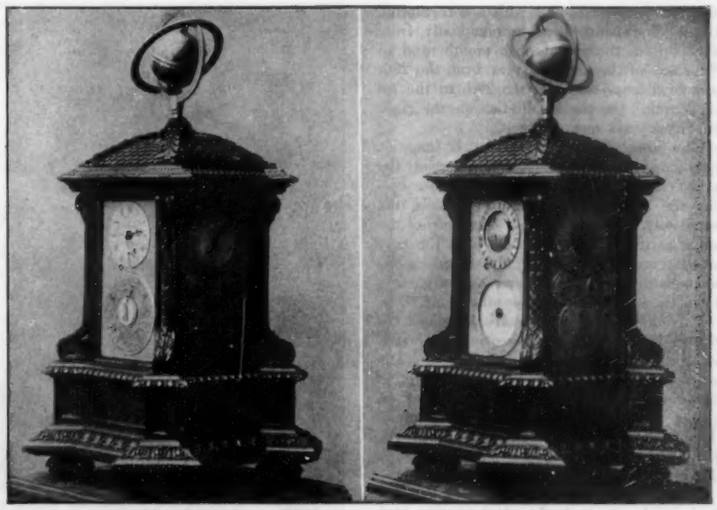
Courtesy General Electric Company

Cutting risers from castings, using illuminating gas

The new method reduces gas costs, as the illuminating gas used is cheaper than either hydrogen or acetylene. The principal advantages are: availability; elimination of delays and handling of tanks; low cost; safety, and chemical and physical properties permitting the use of the gas in a torch equipped with a superheater, thus effecting marked economies in the amount of oxygen required by the cutting jet.



This precise surveyor's traverse through two states was made with the astonishing vertical accuracy of 1/1,000 of an inch per mile



The four faces of the versatile Ueberbacher clock

Government Super-surveyors

IN land surveying operations, the outdoor field work of the Coast and Geodetic Survey, Department of Commerce, almost rivals in accuracy the best measurements made in laboratories under ideal conditions.

An accuracy almost uncanny is shown in the recently completed survey of a line of levels across South Dakota. The line extends from Sioux Falls westward to Edgemont, South Dakota, and forms a loop with another line about 75 miles south, running from Edgemont back to Sioux Falls.

The circuit is 1,035 miles long and the closing error of the circuit, or the difference between the elevation of the bench mark from which work was started and the elevation of the same bench mark computed through the leveling, was only about one one-thousandth of an inch per mile. The Coast and Geodetic Survey's average closing error of circuits of this kind is about six one-thousandths of an inch per mile.

* * *

A Clock That Tells Almost Everything

A REMARKABLE astronomical clock that accurately indicates nearly every time element used by the astronomer, has been constructed by Herr John Ueberbacher, an Austrian residing at Brixen in the Tyrol. This clock was completed only after seventeen long years of painstakinng labor. Its design and construction demanded not only the skill of a first-class mechanic but the learning of an astronomer. The builder, after all his years of patient effort, had counted on disposing of the clock to a German university but the World War with its financial consequences ruled out this possibility, so the clock remains in the hands of its patient maker.

This clock consists of five principal parts, one being fixed on the top of the case, the other four, consisting of various dials, being on its four faces.

The armillary sphere on the top of the clock shows the constellations of stars in their yearly, daily, and even their hourly motions. It is equipped with a meridian circle, while a silver ring on the celestial globe represents the zodiac, and is divided into two equal halves by the elliptic. The globe, showing the constellations and the stars up to the fourth magnitude, moves between the meridian and the horizon, turning according to sidereal time. The sun, the moon and the planets Mercury, Venus, Mars and Jupiter turn outside of this globe in the apparent revolution of the planets, as we see it every day. The whole is moved by clock-work.

The left-hand face in the left-hand photograph shows a twelve-hour dial with the equation of solar time. Below it is an astronomical dial on which the degrees, the zodiac, the twelve months, the monthly length of the days, the four seasons, the age of the moon and her phases and eclipses are indicated.

The right-hand face of the same photograph shows the 24-hour dial. The small dial below it on the left shows the ruling planet; on the right are the ordinary and the leap years.

Beneath these is the chronological dial with five hands. These hands show the golden number, the epochs, the solar circle, the Sunday letter and the Roman indiction. Thus this is a perpetual calendar for finding the movable holidays. The hands change their points at midnight of New Year's Eve.

In the left-hand half of the right-hand illustration, there is a dial with 24 hourly divisions. From a sector the "sun" turns in 24 hours in such way that its rising and setting harmonize through corresponding shifts on both sides.

Underneath is the planetary system of Copernicus. Mercury revolves around the sun in 87 days, 16 hours, 41 minutes, 25 seconds; Venus in 224 days, 16 hours, 41 minutes, 25 seconds; the earth in 365 days, 48 minutes, 46 seconds; Mars in 686 days, 22 hours, 15 minutes; and Jupiter in 4,330 days, 9 hours.

Finally, the right-hand side of the right-hand photograph shows at the top the polytopic dial from which the exact time of each of the five continents may be instantly read off. A plate with the 24 hours turns in 24 hours within a circular ring on which the 360 degrees and the principal places of all the continents are engraved. Below on

the left is a small dial with self-regulating date. The hand leaps automatically from the 30th to the 1st of each month, and in February of the ordinary year from the 28th and in a leap-year from the 29th to the 1st of March. On the small dial on the right the week days may be seen.

The lower dial contains the 12 months, the four seasons, and the number of the year, changing into the following year during the night of New Year's Eve. In the same way, the month hand leaps during the night at the end of the month into the next month, and the hand of the four seasons changes precisely at the hour of the passing from the one season to the other.

All the works of this remarkable clock are driven by two springs, one of them serving as a spare in case the other breaks. The clock runs eight days; it has therefore, to be wound up every week. It moves on pivots and has a compensation pendulum. The total height from the bottom of the little box to the meridian is about 15 inches. The width is about seven inches.

The globe on top has a diameter of 2¼ inches. Inside it is the clock work which drives the planets which revolve outside. In all, forty wheels and springs are in constant motion.

Since the proportions of this clock are so small, the building of the intricate mechanism necessitated an enormously difficult task. This task required great patience, skill and scrupulously accurate mathematical and astronomical calculations.

It took seventeen years of incessant toil to accomplish this work!

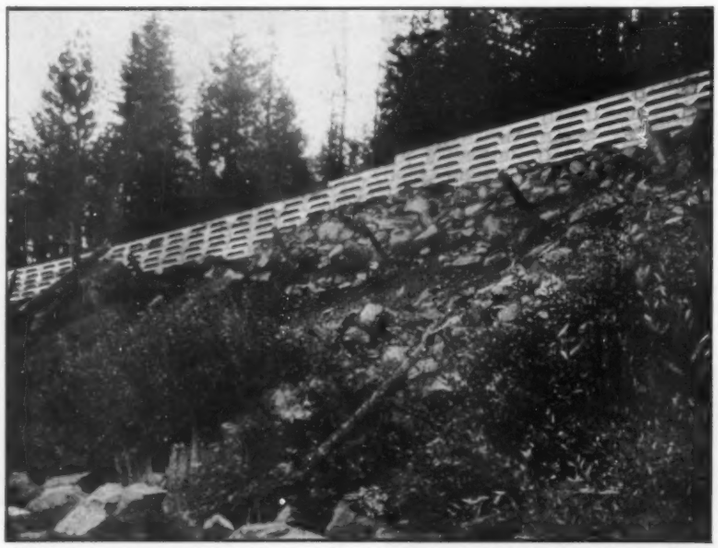
* * *

Concrete Crib Cheaper Than Masonry

THE California Highway Commission recently completed a section of retaining wall on the Pacific Highway in the vicinity of Weed, Siskiyou County, that is made in the form of a crib composed of precast, reinforced-concrete members which interlock one with the other, forming a stable structure. The alternating layers of headers and stretchers are each made up of members five inches square and eight feet long, with necessary lugs for interlocks, cast at either end.

This particular wall is 165 feet long, varying in height from four and a half to seven feet. It serves to retain the roadway slopes at a point where the location is on a hillside, immediately above the Southern Pacific Railroad. The crib type was chosen because of the difficulty encountered in securing a safe foundation for the usual type of masonry or concrete wall, and because of the necessity for ample drainage at this point.

The stretchers are eight feet in length. In favorable places, this construction might be used for dock cribbing



This trim, neat, retaining wall is made of precast, interlocking concrete members

Due to its lighter weight and flexibility, this type of wall has many advantages and can be placed on foundation material that would not support a gravity wall. Water from behind it drains out freely, eliminating another danger.

The total cost of the structure, in place, including backfill, was $1,179.45, as compared with an estimated cost of $1,700.00 for a rubble masonry retaining wall. All of the work was done by common labor.

* * *

Oil Shale, Our Future Oil Supply

THE distillation of shale, which promises to become very important to the entire nation, is not a new way of getting oil at this time of approaching scarcity, but, is merely an old method brushing its cobwebs off after over half a century of disuse in the United States. In France it is older yet, for there the production of oil from shale started in 1838, according to Dr. G. C. Riddell, consulting engineer of New York. In Scotland, oil was obtained from shale before 1850, but the best of the raw material is today exhausted. Shale pits 3,000 feet deep show how the industry once flourished.

In 1850 oil was distilled from shale in Utah and Pennsylvania, and the development of a great shale industry would have resulted but for the discovery of well oil. The "liquid gold" fever, following the development of oil in drilled wells in Pennsylvania, caused the interest in shale oil to dwindle and then die, just as an impending scarcity has brought it to life again.

To date 186 patents have been granted in the United States for the production of oil from shale. Five of these were granted in 1858, 15 in the next six years, and none at all after that until 1891. From 1891 to 1914, ten patents were granted, from 1915 to 1919, 34 and from then to the present time, 107.

The competitive production of oil by distilling bituminous rocks is no longer in doubt, Dr. Riddell states, for in California it has been produced for three years at less than one dollar a barrel, including all overhead charges. This is far below the average cost of American well oil.

The question as to what is to become of the vast amount of spent shale that will result with the development of the industry is puzzling many theorists. The by-product can be used for making pressed, refractory and insulating brick and tile, Dr. Riddell says, and at present it has found lesser uses in road material, concrete building blocks and as a filtering substance in the sugar industry.

That the new shale industry is destined to become as great as the coal industry is now, is recognized by engineers and geologists generally. The new business will be developed in the now sparsely populated regions, Dr. Riddell points out, and town roads, water systems, "movies" and other evidences of civilization will appear there.—*Science Service.*

* * *

Modern Optics

THOSE who are interested in the more technical aspects of general and applied optics will find in the newly published "Proceedings of the Optical Convention" (London, 1927, price three pounds, plus postage and duty) a mine of interest. This large two-volume work of more than 1,000 pages consists of about 100 papers which were presented before the recent optical convention in London. This convention brought together a large number of scientists and industrial leaders whose activities involve them in widely varied fields having in common the science of optics. Hardly an industry can dispense today with this highly developed branch of science.

The range of subjects treated in the "Proceedings" is suggested by the following cross-section: optical glass manufacture; colorimetry; color in relation to printing; color problems in the woolen industry; photometry; illuminating engineering; lighthouse optics; the eye; manufacture of optical elements; spirit levels; sextants; lens theory; optical analysis of sound; speaking films; new advances in microscopy. It is impossible to name here all the subjects considered in the volumes.

This collection is for the reader who possesses a fairly well-rounded background in the field of optics.

* * *

Who Is the Culprit?

A ROBBERY was recently planned, committed, and detected, all within an hour and in the presence of almost the entire membership of the New York Electrical Society. The occasion was a regular meeting of the Society at which Dr. A. P. Link, instructor in psychology at Washington Square College at New York University, described the electrical apparatus and methods which have been developed for psychological tests.

Individuals selected from the audience were sent from the room with sealed instructions. These instructions required one of the individuals, chosen by lot, to commit a robbery in another room in the building. On the return of the group, Dr. Link subjected all of them, guilty and innocent alike, to a modern electrical "third degree." Emotions aroused by the guilt of the "robber" were made evident on the records of the apparatus. An electrical stethoscope, supplied by the Bell Telephone Laboratories, enabled the entire audience to hear the thumping of the heart of the person being examined. When the guilty person was asked questions touching on the robbery which he had just committed, the quickened thumping of his heart was evident instantly.

A second method of detecting guilty excitement on the part of witnesses was demonstrated in the form of an apparatus for measuring the electrical resistance of the human skin. A moving spot of light thrown on a screen in full view of the audience shot clear across the screen when the person under test showed any excitement. Excitement lowers the electrical resistance of the skin. This is especially evident when an effort is made to lie or to conceal the truth. This reaction, Dr. Link explained, is entirely outside the control of the person being examined. With the Electrical Society's "robber" it supplied, as usual, a complete "give-away" of the emotions which the "robber" was doing his best to keep concealed.

The apparatus used in the tests is shown in an illustration reproduced in these columns. In the photograph Dr. Link is seated facing the reader at the end of the instrument table. In front of Dr. Link is a small metal disk which connects with the chronoscope seen at the extreme corner of the table at the reader's right. At Dr. Link's left is the girl witness under examination.

In front of the witness is another metal disk also connected with the chronoscope. Controls for this chronoscope are operated by the male assistant at the reader's right. This apparatus determines the exact fraction of a second which elapses, in each instance, between the question asked by Dr. Link and the response by the subject under examination. The girl in the middle of the side of the table at the reader's right is making records in connection with this determination.

On the forward end of the table, at the reader's left, is a psycho-galvanometer, made according to designs of Dr. David Wechsler. This apparatus measures the electrical resistance of the skin of the subject under examination. Electrodes connected with the apparatus are attached to the subject's arm, which is hidden by the table in this view.

Emotions excited by the questions asked by the examiner are disclosed immediately by a substantial decrease in the resistance of the subject's skin. Between Dr. Link and the subject is a microphone connected with a public-address system, so that the audience could hear question and response. In the rear (standing) is Mr. H. F. Hopkins, who operated the electrical stethoscope seen just at his left. By means of a transmitter attached to the chest of the subject,

Note the header at the extreme bottom of this picture. This interlocks with the concrete stretchers

the rate of heartbeat of the subject was made audible to the audience. The heartbeat quickened when the subject was asked questions arousing emotion.

* * *

Do Motion Pictures Tire the Eyes?

MOTION pictures do not tire the eyes even as much as reading a book does, according to experimental tests made on living subjects by two Los Angeles physicians, Drs. A. Ray Irvine and M. F. Weyman, and described in the *Journal of the American Medical Association*.

There is still a fairly widespread belief that the "movies" injure the eyes, or at least tire them unduly. According to the two investigators named above, more fatigue was evident after 45 minutes of reading current magazines than by viewing either a black-and-white or a colored motion picture for one and one-half hours, if one uses the visual acuity as a criterion for fatigue. Those who suffer eyestrain from motion pictures are those who are unable to accomplish other ocular work without fatigue.

True, some years ago various eye specialists found that the "movies" were injurious to the eyes. But, say Drs. Irvine and Weyman, these opinions are of little value today because of the perfection of the technique which removes the flicker and other objectionable features from the pictures.

In making the tests, three groups of people were used, some being college students and others being business people. In all, more than 150 persons were examined. The procedure was as follows: the visual acuity was first determined by standard tests. The subject was then sent into a projection room and the picture was begun. For the reading tests the same examination was made and the subjects were then sent into a well-lighted office, where they were required to read current magazines for 45 minutes, after which the same tests were made.

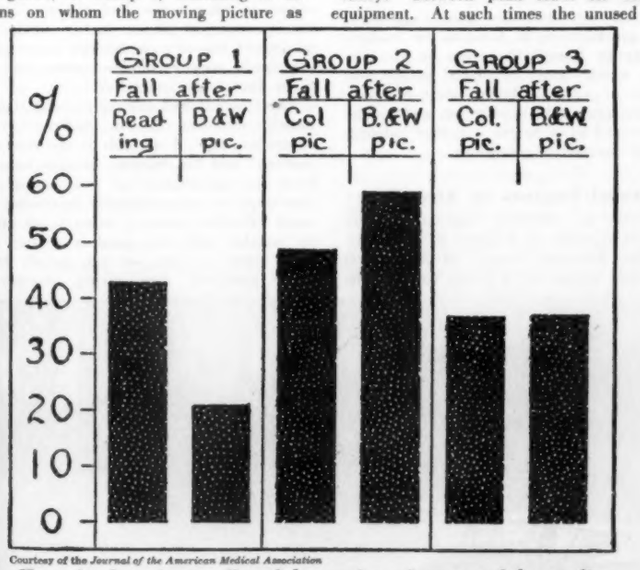
The length of time required to view a picture averaged an hour and a half, which is twice as long as the time used for reading tests, "45 minutes being the maximum time we could keep the subjects reading without discomfort," say the physicians.

Referring to the tables prepared by the investigators, in Group 1, consisting of 68 persons on whom the moving picture as well as the ordinary reading tests were performed, 43 percent showed a fall in visual acuity after reading for 45 minutes, while only 21 percent of the same group, after viewing a motion picture, showed a fall. "An interesting sidelight on this observation," say the physicians, "was that when a group that had been reading for 45 minutes was sent immediately into a projection room, and viewed a picture for one and one-half hours, 83 percent of those who had shown a fall showed an improvement after seeing the picture." They explain this by assuming that the subject was bodily tired or mentally fatigued on entering the room, and the entertainment of the picture had provided relaxation for them. In other words, when your brain and eyes are tired, go to the "movies" and rest them.

Group 2 (see table) consisted of 60 persons—not the same ones who were tested in Group 1. The graph shows a comparison between ordinary black-and-white pictures and colored pictures of the technicolor type. Here, 53 percent showed diminution of visual acuity after a black-and-white picture, and 48 percent after a colored picture. This favors the color process. Group 3 contained 153 persons. It shows another comparison between black-and-white and colored pictures.

Brown Brothers

Testing guilty excitement by means of electrical apparatus. The details of this photograph are explained on this and the preceding page



Courtesy of the *Journal of the American Medical Association*

How visual acuity is affected by motion pictures and by reading. The latter diminishes it more than the former

* * *

The Electric Steam Boiler

CONVERTING electric energy into that of steam is feasible and economical, especially under conditions where there are temporary "valleys" between peak loads on electric equipment. At such times the unused current is diverted to the electric-steam boiler and a volume of steam is built up to be used later.

The process of operation of these boilers is really so simple that it can be told in very few words. High-tension electric current is led directly into the boiler shell by cables and conductors. In the case of the boiler illustrated, each of three tanks take one phase of the 3-phase supply.

Inside the tanks are suspended a number of metallic electrodes. Water is fed into the tanks by the usual valves, pumps, et cetera, and the water itself acts as a resistor. The resistance of the water to the passage of current heats it up to steam-making temperatures.

If no water is in contact with the electrodes, no current flows and nothing happens—the amount of steam produced and the amount of power consumed is thus controlled by the height of water in the tank; or, to put it another way, by the depth of immersion of the electrodes in the water. After that it is just a question of mechanical design of tank and fittings to withstand whatever pressures of steam are required.

All of the electrical energy put into the tanks is used in converting the water to steam. The tanks can be well heat insulated. It is possible to obtain over 98 percent thermal efficiency over long periods. The only loss of energy are those due to the very slight radiation loss and to the emptying of the boiler from time to time in order to get rid of any sediment that may be deposited.

The photograph shown in these columns is that of the largest electric steam boiler ever built. It is now installed in the plant of Price Brothers and Company, Ltd., of Kenogami, Quebec. It is designed to operate at 13,000 volts and has a capacity of 32,000 kilowatt-hours. It is capable of producing 100,000 pounds of steam per hour at the required pressure. The tanks are nine feet, eight inches in diameter and ten and one-half feet long. The entire unit is the equivalent of 3,200 horsepower.

Naturally, compared with the cost of an ordinary fuel-burning boiler installation, that of the electric-steam boiler is altogether lower. Installations of the same type as that described above have been made by the Niagara Falls Power Company and the Ford Motor Company. However, if this type of boiler is employed, electric power must be cheap, and a use for steam must exist. There are, nevertheless, many manufacturing processes where steam is used and where there is an excess of power at times.

Some installations are kept at work steadily, but when the "temporary-excess-of-electric-power" type of installation is made, the electric-steam boiler is tied in with the ordinary fuel-made steam plant. This in turn makes it possible to shut down a part of the fuel-steam equipment while the electric-steam apparatus is working. In cases where plants that buy "blocks" of electric power have a use for steam and do not have a steady demand for the power that they buy, the electric-steam boiler acts as a sort of general "shock absorber," smoothing off the valleys and peaks of the power-demand curve into a more uniform line.

As the amount of water in the tanks at any one time is small, it requires only a few minutes to get the boilers up to steam-producing load. One man easily attends to the installation shown in the accompanying illustration and could take care of two more like it at the same time.

* * *

Animals That Have Trades

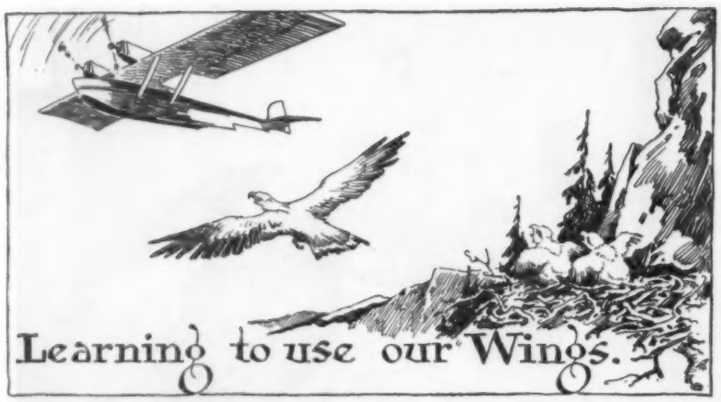
A WRITER in *Our Dumb Animals* (Boston) refers to the trades of animals. "Bees are geometricians," he says. The honey cells are constructed so that with the least quantity of comb material they have the largest spaces and least possible loss by gaps.

The mole is a meteorologist. Eels are electricians. The nautilus is a navigator—he raises and lowers his sails, casts and weighs anchor, and performs other nautical acts. Whole tribes of birds are musicians. The beaver is an architect, builder and woodcutter. The marmot is a civil engineer. He not only builds houses but constructs aqueducts and drains to keep them dry.

Wasps and hornets manufacture paper, and it is said that the invention of paper, as we have it, is due to the fact that a Mongolian got the idea from watching hornets make their nests out of a pulp which they got from weeds and straw and other vegetation.

Caterpillars make silk threads. Here, again, the inventors of silk got their first ideas of manufacturing silk fabrics. Ants are architects and military geniuses. They conduct their affairs on the cooperative or socialistic plan, and may be also regarded as statesmen.

The passage of the electric current in this Kaelin electric steam boiler, installed at Kenogami, Canada, heats the water just as it heats the filament of an electric lamp. There is no noise, no fuel and no smoke. Very little noticeable heat escapes from the heat-insulated shells which surround the boilers



Aircraft are being put to use in peace as well as in war. This department will keep our readers informed of the latest facts about airships and airplanes

Conducted by Alexander Klemin

In charge, Daniel Guggenheim School of Aeronautics, New York University

H. G. Wells and Airplanes

IT has often been said that H. G. Wells, the English writer, is the greatest journalist in the world. After reading his article in the *New York Times* entitled "The Airplane: Wings of Uncertainty," we are inclined to agree with this encomium. Wells brings a remarkable freshness and originality to bear on the problem of airplane utilization.

Wells no longer flies himself. He finds the thrill of flying gone, and the lack of reliability and the hazards of European air services too great for his liking. But this is not due to lack of excellent equipment or navigational aids, according to Wells. It is due solely to the fact that the business and administrative side of air transport is not up to the mechanical side. In the European air lines, petty jealousies between different nations, lack of cooperation, lack of capital and lack of sufficient pilots and reserve planes retard reliability and the resultant flow of passengers.

Instead of small-scale operations, Wells advocates for Europe a huge flying trust with at least 250,000,000 dollars capital that could really organize on an adequate scale. Then, "in a few years the international air service would represent not millions but billions of capital value, and would be sustaining a vast industry beside which the motor-car industry of the world would be a small affair."

We do not think that American conditions are strictly comparable, nor that flight organization in Europe is as bad as the great writer paints it, but there is a good deal to be said for his opinion that flying is now ready for organization on a vast scale.

A Releasable Landing Gear

WHEN flying over large stretches of water, a single-engined land plane may be a source of uneasiness. The fuselage, if built of veneer or dural sheeting, can be made to have adequate flotation

P. & A.

The De Villiers plane suspended from a crane by a hoisting sling. The rear struts carrying a hook are being pulled by a cable, thus releasing the landing gear. The same process would be followed in flight

easily enough, but alighting on the water with a landing gear is a delicate maneuver. The wheels engage the water first and their resistance to motion heads the plane on its nose.

De Villiers, a French designer, has achieved a simple device whereby the landing gear may be readily dropped in case of a forced landing on water. From one of our photographs, some idea of the construction may be obtained. The plane is seen suspended from a crane by a hoisting sling and the landing gear is dropping to the ground. The two rear members of the landing gear have been swung far back by a cable connecting to the pilot's seat, and the hook is no longer in place.

In the other photograph, the plane is shown in the water and being towed to the banks of the river. The only damage likely to result on a forced landing is the loss of the chassis, and also damage to the hot engine when suddenly immersed in cold water.

Improvements for Airships

IN a paper recently read before the *Tau Beta Pi* Alumni of New York City, Lieutenant-Commander Rosendahl of the airship *Los Angeles* makes some illuminating suggestions regarding improvements in airships and in their auxiliaries.

The mooring mast is frequently heralded as the final solution of airship-handling problems. This would be correct, were the winds always horizontal, and were the airship never required to enter a hangar. It so happens, however, that vertical air currents are just as frequent as horizontal ones. When the airship rides at the mast, with only her nose secured, vertical currents may move the stern violently up or down with attendant danger. Commander Rosendahl thinks that airships should therefore be moored quite close to the ground where vertical currents are weaker; that the nose should be held so as give response to the direction of the wind; and that the stern should be free horizontally yet controlled vertically. A knotty specification to meet!

The Naval Station at Lakehurst is investigating seriously a device which coordinates the landing, mooring and handling of airships in one piece of mechanical equipment, reducing the number of ground men required to a dozen or so. Nevertheless, a cross wind at the moment of hangar entry or exit is still a difficulty. Possibly a revolving hangar is the correct solution. There is also need of a hangar design which shall itself be of such a shape as to create a minimum eddying of the air. Careful investigation of this problem in the wind tunnel may aid in reaching a solution.

The chemist still has a challenge in the need for a synthetic substitute for goldbeaters' skin, which is so highly impervious to gas leakage. A number of such substitutes have been tried, some of them producing an even greater gas-tightness than goldbeaters' skin, but lacking the ability to stand the necessary packing and handling. One material known as "cellophane" and resembling the transparent material used to keep candy boxes airtight, is quite effective as regards gas permeability, is cheap and can be applied by rolling on in sheets. Unfortunately it is easily torn and wrinkled. "Viscous latex" is a similar product of equal promise.

We have selected only those suggestions which are likely to be novel to our readers. Commander Rosendahl agrees on the emphasis which should be placed on the production of vertical thrust, when required, from the propulsive mechanism, and on the urgent need of a height indicator independent of barometric conditions.

Diesel Engines in Aircraft

ELMER A. SPERRY, famous engineer and inventor, in a paper presented before the American Society of Mechanical Engineers, makes out a strong case for the employment of the lightened, supercharged Diesel engine in aircraft service.

The Diesel engine is notoriously heavy; in its early use aboard ships it weighed about 450 pounds per horsepower, which is a long cry from the few pounds per horsepower of an airplane engine.

But for airplane use, the engine itself is only one of the elements of weight that have to be considered in connection with the whole power plant. The high-compression Diesel may burn so much less fuel per horsepower hour than the conventional aero engine, that for long journeys the relative advantages of the two types may be reversed. Also with the Diesel, it is possible to use a non-inflammable fuel oil thus eliminating fire risks; and also to employ an oil costing about one-tenth of the price of aviation gasoline, volume for volume. These are possibilities of great importance to aviation.

The Diesel engine suffers, however, from two fundamental handicaps. In the Diesel cycle, where the fuel is injected under pressure during a very brief portion of the cycle, the fuel and air have much less time to "get acquainted" than in the gasoline engine. Accordingly, more air has to be handled, with a corresponding increase in cylinder volume and weight. For a similar reason, the mean effective pressure for the Diesel engine is much less than that of the gasoline engine, which also means an increase in size and weight for a given power.

Mr. Sperry believes that these handicaps will be conquered and the full advantages of the Diesel realized by one or all of the methods of attack outlined in the following paragraphs.

There must be the greatest refinement in detail; parts must be built strongly enough to withstand all stresses, but there must not be an ounce of wasted material.

The two-cycle instead of the four-cycle system may be employed. This means that the working cycle for a given number of revolutions per minute is completed twice as quickly. As a matter of fact, the two-cycle introduces difficulties and complexities of its own, and nothing like a doubling of power for the same size of engine is achieved.

The engine may be made double acting, like a marine engine. Both sides of the piston are then active and power is developed in compact form. Unfortunately, the piston rod has to pass through heavy packing glands, requires intense cooling, and has to be very large and heavy.

The simplest and most promising line of attack, according to Mr. Sperry, lies in supercharging: "I say this is the most important," said Mr. Sperry, "because here we have an opportunity of overcoming our handicaps by very materially increasing our mean effective pressure, bringing it up to an equality with the gasoline engine, and as a matter of fact, we can greatly excel these pressures, thus giving promise of

P. & A.

The land plane, with its landing gear detached, alights comfortably on the surface of the water and is quickly and readily towed ashore

achieving a final result actually excelling the gasoline engine in power per pound."

We wish we had space to follow Mr. Sperry in detail. It will have to suffice to say that he shows that the many difficulties following on excessive supercharging are solvable. Also, with supercharged air at the beginning of the cycle, more air and fuel will be utilized in a smaller volume and therefore weight will be reduced.

There is certainly plenty of room for invention and research in this problem of securing a light aero Diesel engine.

World Airways

ENGINEERS are conservative folk and it is rare to find one of them venturing into the realm of prophecy. Harry Harper, one time technical secretary of the British Aerial Transport Committee certainly "lets himself go" in the *New York Times Magazine*. However, his conception of world-wide airways is based on very real undertakings of an international character.

England, in conjunction with India, Australia and the Dutch East Indies is working actively upon a scheme of an airway from London to Melbourne in Australia, a distance of 12,000 miles and the British Imperial Airways is even now opening an air line between Cairo, Egypt, and Karachi, India, for regular service. By employing this 2,500-mile airline, travelers will save a week on a through England-to-India journey.

The Germans are also daring pioneers, holding the view that while lines through sparsely-populated territory may not show an immediate prospect of profitable traffic, the very existence of such lines will cause economic expansion and bring traffic ultimately. Thus, the German *Luft-Hansa* is organizing a 5,500 mile airway from London to Pekin, extending the present service from London to Moscow. When the survey of the line through Russia and Siberia is completed, night-flying equipment provided, and multi-motored planes put into service, a traveler will reach Pekin from London in about three and a half days as compared with the 18 required today.

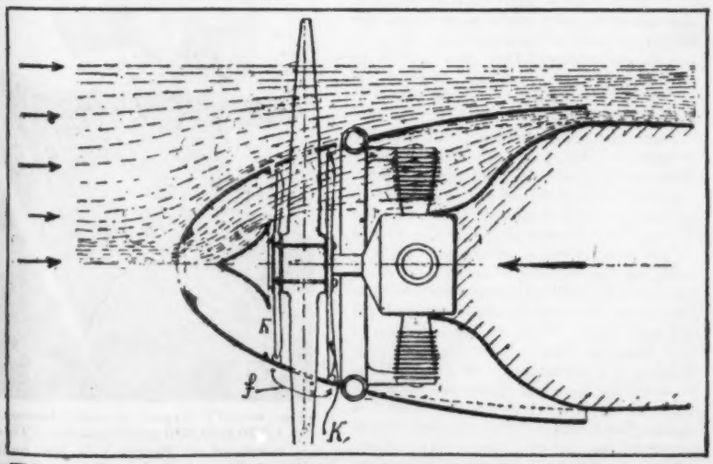
The Germans are also building a new Zeppelin, the *LZ-127*, which is to have a gas capacity of 3,400,000 cubic feet, nearly 50 percent more than the *Los Angeles*. For transoceanic service, reliance may be placed on airships rather than on planes, because of the greater range and carrying capacity of the lighter-than-air type. With such large airships, lines from Seville to Pernambuco, from London to New York, and from San Francisco to Vladivostok are well within the range of possibilities. The "Northern World Air Line" and the "Central World Air Line" may become realities sooner than we except.

Novel Air-Cooling

A FRENCH designer has evolved a novel method of air-cooling engines, in the endeavor to cool them thoroughly with a minimum of head resistance. The method is at present only applicable to small engines of diameter less than the fuselage that follows them. It is shown in diagrammatic form in *L'Aeronautique* and the drawing is reproduced in these columns.

The engine, placed at the front end of the fuselage, is entirely cowled in. A small circular opening is left at the front end of the propeller spinner and allows air to enter. The air impinges on fan blades K, which rotate with the propeller and is then led by suitable guide vanes exactly where it is needed. It then emerges through openings at the cowl as shown to the right on the diagram. These openings or slits can be varied at will according to the atmospheric temperature.

The design of the propeller must be of a somewhat special character as so much of its mid-portion is rendered inoperative, but it might well be designed to have a greater efficiency than the average propeller whose blades are thickened at the root and are inoperative at that point. The whole scheme constitutes a rational attack of the problem.



This new French design of the engine cowling permits the use of a streamline effect, and at the same time, an air-cooled motor

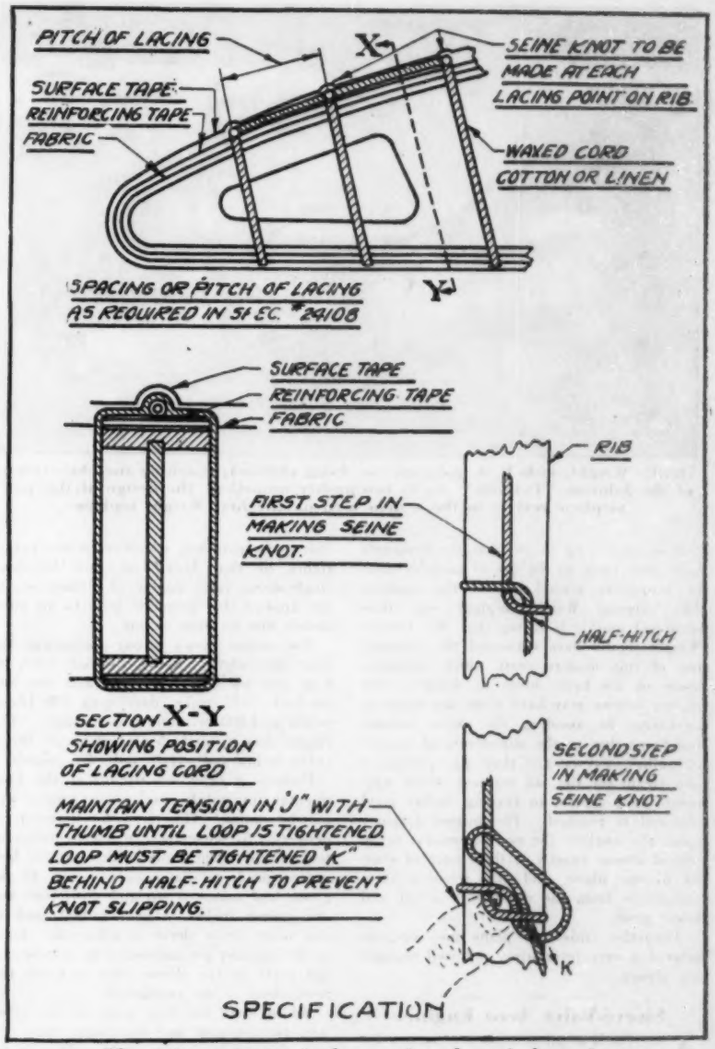
Applying Wing Fabric

THAT airplane shop-methods are remarkably refined and accurate is made plain by C. J. Cleary, who, writing in *Slipstream*, describes the attachment of wing fabric, a process which is typical of the care that has to be employed.

The fundamental materials employed are as follows: *the main fabric*, stretched over the skeleton wing structure and subsequently doped to obtain tautness and rigidity; *the reinforcing tape*, placed on the rib caps, over the fabric on both top and bottom surfaces to reinforce the main fabric and prevent the lacing cord from shearing the threads in the fabric: *the lacing cord*, which is passed completely around the rib, through top and bottom fabric, and knotted securely on the top of the airfoil at the rib edge and covered over with reinforcing fabric; *the surface tape*, used to cover the reinforcing tape, the lacing cord and the knots to render the finished surfaces as smooth as possible. In addition, there are a number of items such as threads, eyelets, grommets, et cetera.

The minute precautions to be employed regarding strength of materials, and other items, are covered by government specifications. Closeness of the lacing, for example, is governed by the section of the airfoil, and is increased with the speed of the airplane, and the depth of the under-surface camber.

Two methods are employed for placing the actual fabric covering. The "envelope" or "pillowslip" method uses a cover made by sewing together widths of fabric cut to proper pattern to form a covering for both sides of the airfoil. This is pulled over the wing structure in much the same manner as employed when placing a pillowslip on a pillow. The only seam is the machine-sewed seam at the trailing edge. In the "blanket" method, widths of fabric are cut to pattern to form a covering for both surfaces of the wing. The blanket is of sufficient size to pass from the trailing edge over the top surface, around the entering edge, and over the bottom surface of the wing to the trailing edge again, where both edges of the cover are hand sewn.



The various processes in the covering of an airplane wing

The Johnson "Twin-60"

MANY of our best designers and constructors are steadily working on the problem of producing an airplane which will be entirely suitable for private ownership and inexpensive every-day use. One of the most interesting efforts in this direction is the Johnson "Twin-60," built in Dayton, Ohio, and as its name implies, equipped with two engines of 30 horsepower each.

These engines are the "Bristol Cherubs," rated at 29 horsepower at 2,900 revolutions per minute, air-cooled, light in weight and of simple two-cylinder opposed construction. Special attention has been paid to the engine mounting, and the entire power plant, less fuel tank, can be replaced in a few minutes. This is due partly to the fact that the engine instruments themselves are located on the engine mounting. They can readily be seen from the cockpit, yet all difficulties of long shafting and tubes are avoided.

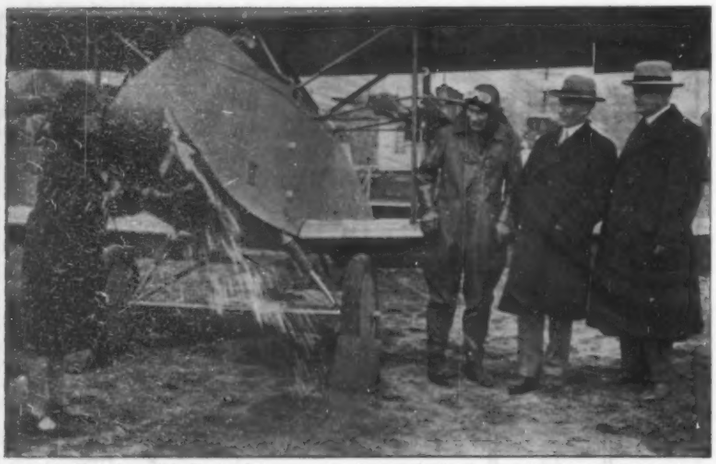
There is a great temptation for the pilot to fly with engine "open wide" at times. On the "Twin-60," the throttle controls are installed in such fashion as to prevent their being opened full under normal conditions, although both engines can be operated at full throttle when occasion requires. The plane carries eight-hours' cruising supply of fuel, and the makers report a mileage of 20 to the gallon of gasoline.

In spite of the low power, a high speed of 75 miles per hour is reported, coupled with a landing speed of only 25 miles per hour, with full fuel-supply and two passengers. Flight on one engine has apparently been found possible in spite of the low power. The take-off is 150 feet, and the landing run is even shorter, thanks to the brakes. The gross weight is 1,320 pounds, and the wing area 194 square feet.

In addition to these general characteristics which appear so satisfactory, the design embodies a number of interesting features.

There is always a loss of efficiency in the airfoil due to the tips. The air flows around the tips from the region of pressure under the airfoil to the region of suction above, producing detrimental tip-forces. A partial remedy is to shelter the tips with fins. In the Johnson design, the vertical tail-surfaces, which have to be employed in any case, also serve as end-shielding fins and thus render the stabilizers more efficient. While such a device has been long suggested, this is the first time we have noted its employment in practice. The arrangement is clearly seen in one of our photographs.

Wheel brakes now seem to be accepted airplane practice. To prevent nosing over with the use of wheel brakes, the front wheels have to be placed somewhat further forward than the center of gravity. This means an extra load on the tail skid. In the "Twin-60," the primitive tail skid has been replaced by a small tail wheel, which casters in any direction and is mounted on compression rubber disks. This helps in the take-off and in ease of handling on the ground; one man can move the plane from the hangar to the field, and a "dolly" can be entirely dispensed with.



Orville Wright, with E. A. Johnson (in flying clothes), watching the christening of the Johnson "Twin-60." In its two pusher propellers, the design of this new airplane reverts to the system used on the first Wright biplane

It is interesting to see that the designers have gone back to the use of pushers—that is, propellers placed behind the engines. The original Wright biplane was thus equipped and it is fitting that Mr. Orville Wright should have witnessed the christening of this modern craft which embodies many of his basic ideas in design. The pusher screws may have some aerodynamic advantage in avoiding the extra parasite resistance due to the slip-stream of tractor or pulling screws, and they also provide a slip-stream for the tail surfaces which augments their control in taxying, before good airspeed is reached. The pusher arrangement also enables the two passengers to be placed almost exactly at the center of gravity of the plane, and also removes them completely from the discomfort of oil and burnt gases.

Altogether, this new plane may be considered a very interesting and well thought out design.

Sleeve-Valve Aero Engines

A NUMBER of advantages are claimed for the sleeve-valve automobile engine, over the usual poppet-valve type, among these being less noise, less wear and more endurance. In aero-engine practice, there is also the advantage of lesser height, by reason of the absence of any overhead valve-gear. Accordingly, several firms are turning their attention to this novel form of aero engine.

The Panhard-Levassor Company of France has built a 450-horsepower, 12-cylinder V engine of sleeve-valve type which has successfully accomplished a 240-hour endurance test in a competition for a 2,000,000-franc prize offered by the French Government. The sleeve-valve undoubtedly had much to do with this lengthy period of unbroken run. Also the height of the engine was only 35.4 inches as compared with 49 inches for a similar engine of the poppet type.

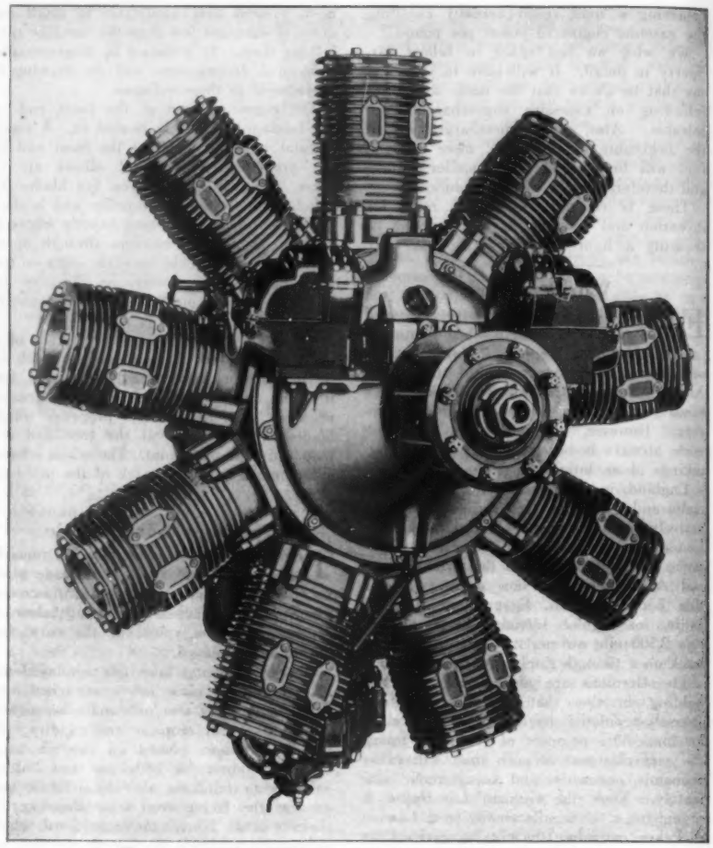
In the United States, the Continental Motors Corporation, which owns the patent rights to the Argyll or Burt-McCollum single-sleeve valve engine of British origin, has applied this principle both to an automobile and an aero engine.

The engine shown in our photograph has nine air-cooled cylinders, radial, each of four and one-half inch bore and five and one-half inch stroke, developing 220 horsepower at 1,800 revolutions per minute. The engine has a total displacement of 787.25 cubic inches and weighs only 475 pounds.

Perhaps a brief description of the Continental automobile single-sleeve engine will not be amiss. This is a 6-cylinder type, delivering 57 horsepower at 3,000 revolutions per minute. The crank, which runs at half engine-speed, oscillates each sleeve 49 degrees, and moves it up and down one and one-quarter inches. The resultant path at any point on a sleeve is elliptical. Ports in the cylinder are uncovered by corresponding ports in the sleeve once in every two revolutions of the crankshaft.

While there are four ports in the cylinder, two exhaust and two inlet, there are only three ports in the sleeve. The sleeves are lubricated by oil spray from the crankshaft. Operation of the sliding member is through a single universal driving-connection of unusual design formed in the flange at the bottom of the sleeve. A special seat or socket is machined in the lug on the flange, and into this fits a case-hardened ball. A crank on which the ball fits, a cross-shaft and a worm-wheel provide a very neat valve-operating mechanism. It is claimed that it is impossible to assemble the unit without providing correct valve-timing.

Side view of the Johnson "Twin-60." Noteworthy are the vertical tail surfaces which prevent end loss on the stabilizer and increase its efficiency



Front view of the Continental sleeve-valve aero engine

Aircraft Beacons

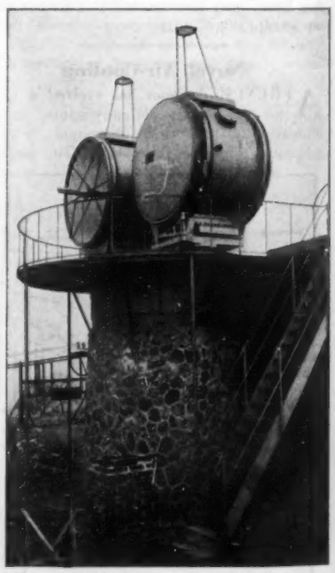
HOWEVER helpful the magnetic compass and the radio beacon may be, the lighting of airways will always be necessary. H. C. Ritchie and C. T. Ludington, in recent papers presented before the Society of Automotive Engineers, set forth the remarkable progress which has been made in aircraft lighting on the airways, at the airport or landing field, and on the plane itself.

Perhaps the most interesting part of these papers deals with the large routing-beacons. Early experiments conducted by the Army Air Service involved the use of powerful searchlights directed towards the zenith. In this case the eye of the aviator did not receive direct light from the searchlight, but only the light reflected from moisture and dust particles in the air. Immense ranges were attained, but the utilization of reflected light meant too great an expenditure of power and money.

United States Air-Mail engineers soon decided that airways should be marked with smaller units consisting of revolving incandescent lamps, throwing a beam but a few degrees above the horizon. The present Air-Mail system uses a 24-inch incandescent-lamp beacon of approximately 7,500,000 candle-power, set on steel towers 53 feet high, at intervals of approximately 10 miles. A suitably geared electric motor drives the light at a speed of approximately six revolutions per minute. This gives a flash in any one direction every ten seconds. A high-grade silvered-glass parabolic mirror is used with this beacon.

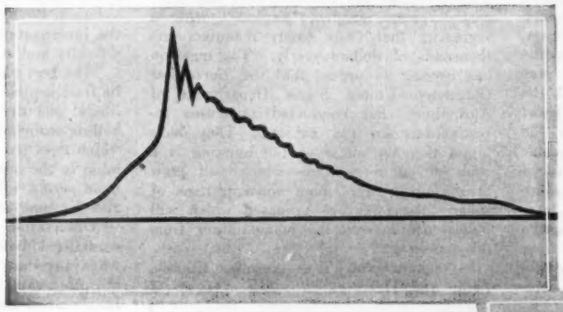
There are many problems still awaiting solution in the design of these beacons. Since aviators will fly from light to light, the regular revolution of the beacon is not perhaps the ideal condition. One suggestion is that the light should oscillate to-and-fro on the route in one direction and then only swing to the opposite direction and again oscillate. By such an arrangement the aviator on the route would perceive the flash for a longer period. Since all lights, no matter how powerful, lose a great deal of their distance penetrating power in fogs, perhaps it would be better to place less powerful lights at very short intervals, say 1,000 feet apart. Since certain colors and wavelengths penetrate fog and mist better than others, possibly another kind of light other than the white incandescent light should be employed —Neon gas tubes for example—with suitable reflectors.

There is one beacon which is always referred to with awe, but which in reality has little utility. We refer to the French beacon on top of Mount Valerian, near Dijon, the largest in the world. This is reported to have a range of visibility of 300 miles in clear weather. It has a candle-power of 1,000,000,000 and serves mainly to guide aircraft en route from Paris to eastern Europe. The light-sources consist of eight automatic electric arcs and four spare burners, each located behind Fresnel lenses which produce the desired concentration of the rays. The lights are arranged in two groups, with each group on a separate revolving platform as illustrated below.



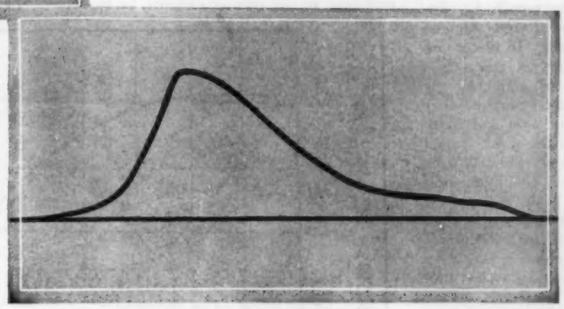
The world's largest aircraft beacon, of 1,000,000,000 candle-power. This is mounted on Mount Valerian, near Dijon, France, and in clear weather has a visibility of 300 miles

The first picture of that "knock"



This is the "knock" in your motor

This shows photographically what occurs in the engine cylinder as carbon forms, when regular gasoline is used. The increased heat and pressure created by the carbon cause the gasoline to explode too quickly, with the result that there is an accumulation of high pressure heat waves which strike against the cylinder walls so violently as to produce an audible metallic sound. The bumps in the line are that "knock."



This is how "ETHYL" knocks it out

And this shows photographically what goes on in the same cylinder under the same conditions when regular gasoline is treated with "ETHYL" fluid. Note the absence of "knock-bumps"; the evenness of the pressure changes. The "ETHYL" fluid has neutralized the heating qualities of the carbon deposits and by maintaining the normal combustion rate of gasoline has turned the increased pressure due to carbon into increased power.

THESE PHOTOGRAPHS were made possible by a special instrument invented by General Motors Research Laboratories to find out what goes on in an automobile engine's cylinder when "knocking" occurs.

That invention led to the discovery that what you may call an "engine knock" or a "spark knock" is in reality a *fuel knock*. It is due to the tendency of a regular gasoline to explode too quickly as carbon forms and increases temperature and compression (pressure).

Having determined the character of "knocking," General Motors developed "ETHYL" fluid, a patented chemical compound which when added in very small quantities to regular gasoline forms Ethyl Gasoline, the most effective "anti-knock" fuel yet known.

Ethyl Gasoline transforms carbon deposits from a liability into an asset. It produces more power on hills and heavy roads. It gives a faster "pick-up," reduces gear-shifting, lessens vibration and engine wear and tear; and saves the trouble and expense of carbon removal.

Ethyl Gasoline has increased the motoring satisfaction of hundreds of thousands of car drivers. It is destined to play a still more important part in the automobile history of the future. TRY IT.

ETHYL GASOLINE CORPORATION
25 Broadway, New York

ETHYL GASOLINE is now generally available throughout the United States and Canada through the following oil companies, licensed to mix "ETHYL" fluid with gasoline. The "ETHYL" trademark on the pump is your protection.

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In the World of Chemistry

A Department Devoted to the Advancements Made in Industrial and Experimental Chemistry

Conducted by D. H. Killeffer

Texas Potash by Pipeline (?)

RECENT investigations made by the United States Geological Survey have shown that immense deposits of potash exist in seventeen counties in Texas and one county in New Mexico and much interest has centered around the possibilities of mining or otherwise recovering this essential ingredient of chemical fertilizers. At present a large part of the potash consumed in America is imported from Germany and France and it is expected that the Texas deposits may render us independent of these foreign sources.

Among the interesting speculations as to methods of getting Texas potash to the market is that suggested by J. W. Turrentine before a recent meeting of the American Chemical Society that the potash be dissolved in water underground and pumped by pipeline to the gulf coast. In discussing his idea, Mr. Turrentine said:

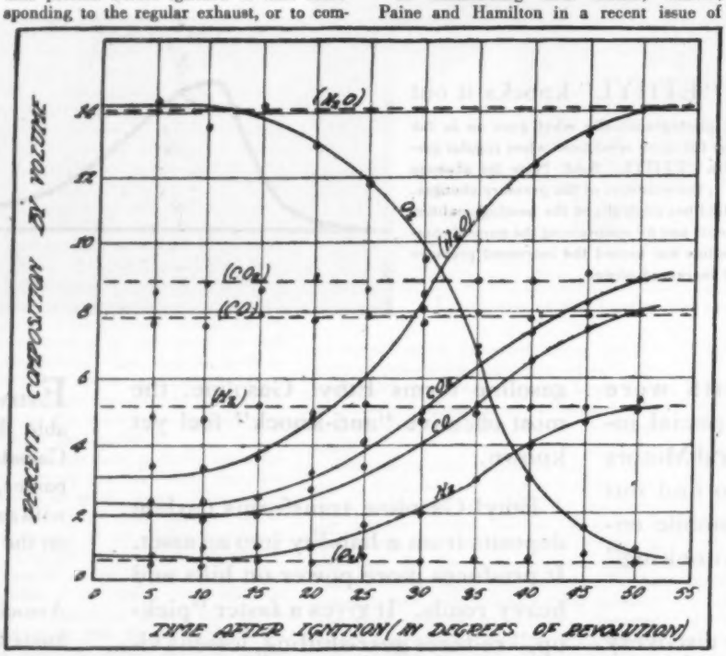
"If Texas potash could be gotten to the Gulf Coast, its delivery therefrom by water transportation to the Middle West and South and even the Atlantic Coast states would be greatly facilitated. Unfortunately, the area underlain by potash is over 300 miles distant by straight line from the nearest seaport and by rail considerably farther. This would appear to be the inescapable minimum of rail transportation.

"The Texas potash area at its lowest altitude is 2,500 feet above sea level. Could pipe-line transportation employing gravity flow be used to deliver a concentrated brine to the seacoast, there to be processed for the preparation of concentrated potash salts? Crude petroleum is economically transported by pipe-line distances as great as 1,400 miles at rates of from 15 to 77 cents per barrel, or an average of 42 cents per barrel, depending on variables such as distances, size of pipe, topography of country traversed, and climatic conditions. A concentrated potash brine as obtained from the leaching of polyhalite would contain a maximum of 6.5 percent, or 28 pounds of K_2O, of a fabricated value at 50 cents per unit of 70 cents per barrel. (A unit of potash is 20 pounds of K_2O.) The average charge for pipe-line transportation being approximately 0.09 cent per barrel per mile, this rate applied to a 6.5 percent potash brine is equal to 0.06 cent per unit of K_2O. On this basis the cost of pipe-line transportation from the Texas field to the Gulf Coast, a distance of 300 miles may be estimated at about 18 cents per unit of K_2O. This estimate is based on the average of rates charged and not on costs."

Gasoline-Engine Researches

THE importance of gasoline engines in modern civilization is leading to active research to find ways to make them more economical in operation. The studies carried on at the Research Laboratories of the General Motors Corporation, and recently reported to the American Chemical Society by Lovell, Coleman and Boyd, present an interesting and important conclusion relating to the mechanism of the explosion in the cylinder. These investigators equipped a motor with a special valve through which samples of the burning mixture could be removed for analysis at any desired point in the cycle. By analyzing these samples obtained at various points during the stroke they are able to follow the course of the reaction within the cylinder. They say:

"The results shown graphically in the accompanying figure, in which the composition of the gases obtained from the engine cylinder at different times are plotted against time, are typical of the data which were secured. These data were obtained from an air-cooled engine operating on gasoline at 1200 revolutions per minute, at a mixture ratio of about 75 percent of the air required for complete combustion, or at approximately the mixture ratio for maximum power. The horizontal dotted lines represent the composition of the exhaust, which was sampled at the same time as the gases in the cylinder. The constancy of the exhaust composition serves as a check upon the operation of the engine, and in particular shows that the fuel-air ratio was unchanged during the series of experiments. The solid-line curves show how the gas taken from the burning mixture at various points in the cycle gradually changes its composition from that present before ignition to that corresponding to the regular exhaust, or to complete combustion so far as the oxygen present permits.



After incorporating a special valve in the cylinder of gasoline engine, so that samples of the burning gases could be taken as desired, tests were conducted which gave the above set of curves. The full lines are cylinder gases and the dotted lines, exhaust gases, sampled simultaneously

"The form of the curves indicates that the mixture in the combustion chamber is probably almost homogeneous. There is no abrupt break in the curve, such as might be expected to be present if there were a narrow zone of flame moving progressively across the cylinder, within which the combustion reaction completed itself, so far as the air present permitted. This does not mean at all that a 'flame' did not proceed through the chamber, as there must have been a spread of something through the charge that marked the beginning of combustion. But the data do seem to show that the combustion reaction was of considerable duration, and that during this period it was apparently going on substantially throughout the combustion chamber."

Attacking the problem from quite a different angle, Professor George Granger Brown and his co-workers at the University of Michigan have studied the effect of nitrogen added to an explosive gas-mixture in a bomb, and they find that this dilution has a marked effect on the tendency of the mixture to detonate. In other words, the addition of nitrogen, or presumably any other inert gas, to the explosive mixture in an engine should reduce its tendency to knock.

"Explosive" Chocolates

ALTHOUGH comparatively safe and not subject to regulation by the Bureau of Explosives, we are informed that chocolate-coated cream candies "explode" with a regularity that costs candy manufacturers thousands of dollars yearly. The question has become so urgent that the Bureau of Chemistry, United States Department of Agriculture, has conducted numerous investigations on the subject. They have found that the cause of the bursting is a class of micro-organisms which will grow in the presence of high concentrations of sugar. Remedies are proposed which will reduce the loss to the manufacturer from this cause.

In summarizing their results, Church, Paine and Hamilton in a recent issue of *Industrial and Engineering Chemistry* state:

"All the evidence points to the conclusion that yeasts tolerant of high percentages of sugar syrup are capable of causing bursting in chocolate-coated creams, and that the bursting is primarily due to the forming of minute quantities of gas in the cream through microbial activity.

"The yeasts obtained from burst commercially manufactured confections and utilized in these conclusive experiments were of various types. While certain ones would be termed 'torulae' when grown on the usual culture media, their growth in sugar media and in fondant resulted in spore formation or, at least, in a tendency to yoke formation in all but one yeast from spotted soft sugar.

"The presence, in chocolate-coated creams, of yeasts active in fermenting sugar solutions indicates that some means must be devised in candy factories to develop a cream of high syrup density. Such a cream may be made by the use of a high proportion of glucose and invert syrup, or by the addition of invertase, wherever such an adjustment does not materially alter the qualities desired. The sanitary conditions of the factory and the soundness of ingredients, such as fruit pieces, should also be regarded by the manufacturer. Otherwise, the bursting of chocolates now causing a large annual loss to the confectionery industry, both retail and wholesale, will continue as it is today, an always present problem."

Paine, Birckner and Hamilton, continuing the investigations, suggest a remedy for the difficulty and state:

"The best plan in combating fermentation in fruit centers is to combine the use of a liberal quantity of invertase with heating at boiling temperature for the maximum period which does not cause objectionable deterioration in the quality of the fruit. This maximum period will vary with the kind of fruit and to some extent with its condition.

"Observation of numerous batches of cordialized fruit-center candy showed that when invertase was added in about twice the proportion used in plain fondant candy, fermentation occurred only rarely. The use of invertase alone in this type of confectionery solves the problem to a great extent. Although no controlled experiments in which the use of invertase was combined with preliminary heat treatment of the fruit have been made, it seems certain from the foregoing considerations that this would reduce fermentation to a point of practical negligibility.

"The action of invertase increases the proportion of liquid to solid phase and softens the fondant. This effect is usually desired. If, however, the proportion of invertase used to prevent fermentation is found in any case to render the fondant too soft, this may be corrected by increasing the stiffness of the fondant when prepared. This is accomplished by increasing the boiling temperature to which the syrup used for making the fondant is concentrated."

Fire Hazard of Steel Wool

NO one ordinarily thinks of steel as possessing any fire hazard at all but when it is cut into the fine filaments of steel wool it becomes a very real fire hazard. The burning of steel wool is particularly dangerous because it does not produce either flame or smoke to give warning. A fire in steel wool can be extinguished readily by the generous application of water or the product of one of the modern foam-producing extinguishers. The use of a carbon-tetrachloride type of extinguisher is dangerous because in the presence of finely divided steel and air, phosgene, a deadly poison, is formed, and the heat generated by this reaction is likely to reignite the wool.

". . . by any other name . . ."

THE term "methanol" has been officially adopted by the United States Public Health Service as representing "wood alcohol," and will be used in future in lieu of the latter term in all correspondence and regulations. This action of the Public Health Service follows that taken some years ago by the American Chemical Society who adopted this term to prevent confusion in the public mind between methyl or wood alcohol, a deadly poison, and ethyl or grain alcohol.

Sprayed Rustless Coatings

A RECENT dispatch from Germany mentions the use there of metallic zinc sprayed in a molten condition onto a metal surface by the aid of compressed air (Schoop process). This literally shoots the fine particles of zinc onto the surface at a velocity of two to three thousand feet per minute and thus secures a firmly adherent coating comparable to a "cold weld." It has been shown that with this metallizing

process the formation of rust is impeded and at the same time the seams and riveting of the surface are reinforced. The expense of spray zincing is of course higher than that of painting but the coat persists far longer and has proved its worth, particularly in the case of gasometers, under unfavorable climatic conditions.

Thallium in Rat Poisons

RECENTLY, in this department, attention was called to the value of thallium salts in fighting insect pests. Since that item was written, word comes that the thallium supply of the world has been cornered for use as an ingredient of rat poisons. Thus another rare element becomes commercially important.

Rubber Outwears Steel

A RUBBER lining for grinding mills has been found to outwear steel for the same purpose. The mills in which it was used were of the type known as ball mills, used for fine grinding of wet ceramic materials. After eighteen months of service, the wear on the rubber lining was too small to be measured. Not only did the rubber lining wear longer than steel but it actually increased the efficiency of the mill.

Nitrophoska

A CONCENTRATED fertilizer containing all the elements necessary for fertilizing plants is being marketed by the German combine, *Interessen Gemeinschaft für Farbenindustrie aktien-Gesellschaft*, under the name Nitrophoska. This fertilizer contains 51 percent or more of nitrogen, phosphoric acid and potash in a form easily assimilable by the plant. It is being made at the rate of 10,000 tons monthly. Efforts to use such highly concentrated fertilizers in this country are showing promise of success after numerous failures of such things when tried in unskilled hands.

Anti-Knock Fuel Research

THE British Air Ministry has recently announced the findings of its research department in an investigation "to complete a rational explanation of the cause of detonation in engines using liquid fuel, with special reference to the chemical side of the problem." The investigation included an experimental and theoretical study of low-temperature oxidation of liquid fuels in air, in conjunction with engine experiments to determine the relationship between detonation and observed chemical action. The final conclusion, which is regarded as a discovery of considerable importance to researchers on the "antiknock" problem, is in part in the following terms:

"It is found that detonation in an engine using liquid fuel is due to the formation of organic peroxides, which become concentrated in the nuclear drops during compression and ignite them simultaneously when the detonation temperature of the peroxide is reached."

This conclusion will be received with interest on this side of the Atlantic, where investigators have admitted their inability to reach any final and definite conclusion on the subject. It seems highly probable that this conclusion is only a part of the explanation of the phenomenon of knock and that much more remains to be done before it can be applied practically.

Improved Method of Wood Distillation

BY distilling wood-waste saturated with magnesium chloride solution at a comparatively low temperature, Professor Carl G. Schwabe, of Berlin, claims to obtain higher yields of methanol and acetic acid than is customary. If this process should be successful, it will be of great benefit to the wood-distillation industry which now finds itself in an unenviable position because its products are being made more economically by synthesis.

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.

The Weather's Relation to Broadcasting

HIGH correlation between radio reception and the weather is unlikely, according to Dr. Greenleaf W. Pickard, who has studied the effects of the weather on radio since 1906, and his conclusions are that the activities of the sun and terrestrial magnetism are more to blame for poor reception than the weather.

"One of the outstanding problems today is the nature and cause of those atmospheric charges which produce such diversified effects as weather, magnetic storms and disturbances in radio reception," said Dr. Pickard. "The problem is meteorological. If the earth had no atmosphere there could be no weather and on an airless planet there could be no long-distance radio communication.

"The only known important force which acts upon the atmosphere is the complex radiation and emission from the sun. Changes in this force are caused in two ways; first by the movements of the earth with respect to the sun, and second by the actual variations in solar radiation. If the sun maintained a constant radiation, we should have only to consider the earth's rotation on its axis, which gives us night and day, and its movement in an orbit around the sun, which, by the changing angle of the solar rays, gives us the seasons. If these movements were the only factors involved, weather, terrestrial magnetism and radio reception would follow the calendar to a far greater extent than our measurements indicate," said Dr. Pickard.

"But in the scheme of things we find that weather does not go according to the calendar, nor does radio reception. The visual evidence of sunspots, faculae and prominences tells us that the sun is periodically disturbed and measurements of the light and heat received by the earth have shown that this varies in general correspondence with the visible changes on the sun's disk, in fact, definite relations have been established between solar changes and weather, which have already been usefully applied to weather forecasting."

Eliminating a Hum Caused by Oil Burner

A NUMBER of questions have been received regarding means of eliminating humming disturbances in radio sets caused by certain types of oil burners.

The method used by one radio follower may prove useful to other radio enthusiasts who are experiencing the same annoyance. "My radio set is electrically operated and when the oil burner was cut in on the same circuit such a drop in voltage took place that a terrific interference was created," said this experimenter. "I tried a number of ways and various devices including a pair of balanced condensers, grounded and cut in on the oil-burner circuit, but all in vain.

"The house was supplied with electricity by two Number 14 wires. They were replaced with three Number 6 wires, one neutral and two active. The neutral wire, after passing through the various switchboxes, et cetera, was grounded to a cold-water pipe. One active wire and the neutral one supply the radio only. This resulted in complete elimination of the noise.

"The current is 110-125 volts, alternating current, but a 225-volt meter is installed in the circuit. In addition to the complete elimination of interference, the following advantages are noted: House lights are brighter; bell service fully 50 percent stronger; oil burner much more efficient; battery charges in one-third less time and volume of the reception is materially increased."

While this scheme was perfectly satisfactory in the case mentioned, it must be stressed that such changes in wiring are not to be attempted without full consent from the company supplying the current, and then only by a competent electrician.

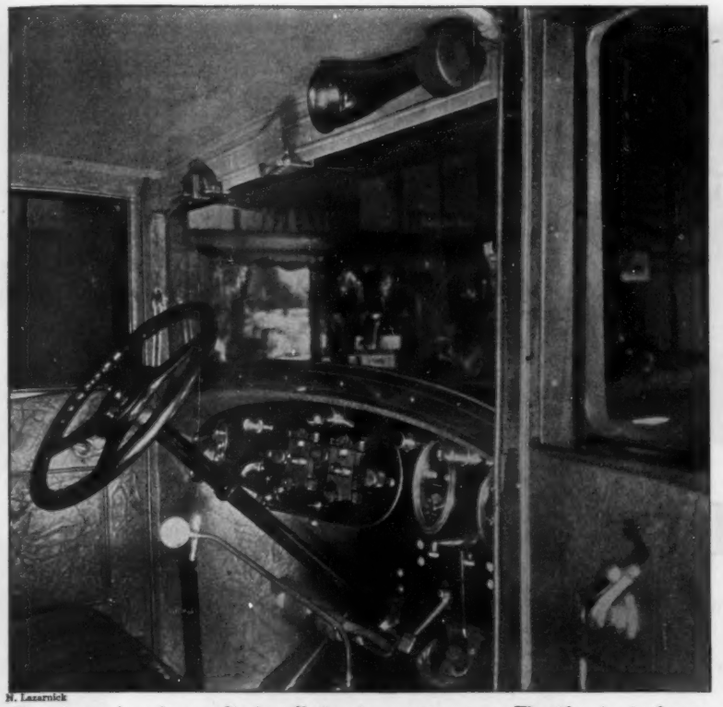
New York Is Best Market

A SURVEY made by the Department of Commerce indicates that New York State is an outstanding market for the sale of radio receiving equipment in the United States. Illinois is rated as second, Ohio third, and Pennsylvania fourth. In groups, the east north-central states lead, with the west north-central states second and mid-Atlantic third. These figures were arrived at through averaging the points of origin of applause mail from about 20 broadcasting stations using power outputs of 5,000 watts or more, and through data obtained from actual sales.

The percentage of the total market for radio apparatus in the United States is credited to certain states as follows: New York, 9.301; Illinois, 8.308; Ohio, 7.555; Pennsylvania, 6.835; California, 5.647;

Herbert Photos

Captain Leonard Plugge, of London, England, picks up concerts wherever he travels in Europe, by means of a 9-tube loop receiver. The set's tuning controls are attached to the instrument board of the car and the loudspeaker unit is built into the roof. Thus the set is always available for use



N. Lazarnick

Here is an American radio installation in a motor car. The idea is similar to that of Captain Plugge, illustrated on the opposite page. Here the tuning dials are made to blend with the regular instruments of the car. We may see many more such installations on pleasure cars in the near future

Massachusetts, 4.451; Wisconsin, 3.453; Iowa, 3.093; Indiana, 3.783; Michigan, 3.971; Minnesota, 3.446; Missouri, 3.966; Oklahoma, 2.480; District of Columbia, 0.499; Louisiana, 0.685; Oregon, 0.355; Rhode Island, 0.792; Alabama, 0.531.

"The distribution of radio apparatus is important in that it considers the economical distribution of an industry producing, at manufacturers' prices, in excess of 170,000,000 dollars annually, exclusive of such items as batteries," said H. E. Way of the Department of Commerce. "In 1921 the prospective purchaser located sources of supply with difficulty. Five years later in excess of 12,000 dealers serve the needs of the broadcast listener with an almost infinite variety of products.

"At first, with slowly growing momentum, the idea of using the phenomenon of wireless as a means of popular entertainment spread throughout the world. The inertia of governmental action deterred its spread, but during 1925 the exports from the United States of this commodity totaled 10,000,000 dollars, while the United Kingdom shipped 6,500,000 dollars worth."

An Ideal Location

THE ideal place for radio reception, despite the frequent displays of aurora borealis, is Godhaven, Greenland, according to Hugo Holten-Moeller, manager of Station OGG, Godhaven, in a report to G. A. Wendt of the Canadian Westinghouse Company.

"In Godhaven there is no weakening of signals, no fading or disturbance, and the northern lights have no effect whatever on radio reception, according to my observations," said Mr. Holten-Moeller.

"I have been carrying out a lot of experiments in this respect, and have rendered a carefully compiled report to my Government." [Denmark exercises a protectorate over Greenland.] "We have been aided here by Dr. Ljungdahl, the Swedish Doctor of Philosophy who was in charge of the newly erected magnetical observatory.

"We have cooperated in order to see whether there was any relation between static and the magnetical disturbances recorded on his instruments. We found none whatever.

"In regard to the northern light, I can only state that it has no effect whatsoever on radio."

Holten-Moeller has cooperated with four stations in the United States in the transmission of special Arctic broadcasts. Each station—KDKA, Pittsburgh; KYW, Chicago; WBZ, Springfield, Massachusetts, and KFKX, Hastings, Nebraska—presents four programs each winter of official and personal messages for dwellers within the Arctic Circle. The programs were inaugurated three years ago, and are conducted on schedules prepared a year in advance.

Since KDKA has a powerful 63-meter transmitter for voice and telegraph, much fine experimental work has been carried on between it, Holten-Moeller and stations of the Royal Canadian Mounted Police in the Northwest Territories. Constable Maurice Timbury, stationed at Pond's Inlet, in northern Baffinland, has an experimental set, C-5AO, with which he has been very active.

Holten-Moeller broadcasts daily. At 19:45, Greenwich Meridian Time, he transmits on 1,700 meters, and at 20:00, Greenwich Meridian Time, on 575 meters. He has advised Mr. Wendt that he first calls his Danish listeners, and then gives his Canadian friends a call.

"Experiments on short waves," wrote Holten-Moeller, "have been somewhat handicapped by restrictions regarding power, but I look forward to a good deal this winter, and may even be able to broadcast Eskimo songs with such strength that they may be rebroadcast from Canadian and United States stations.

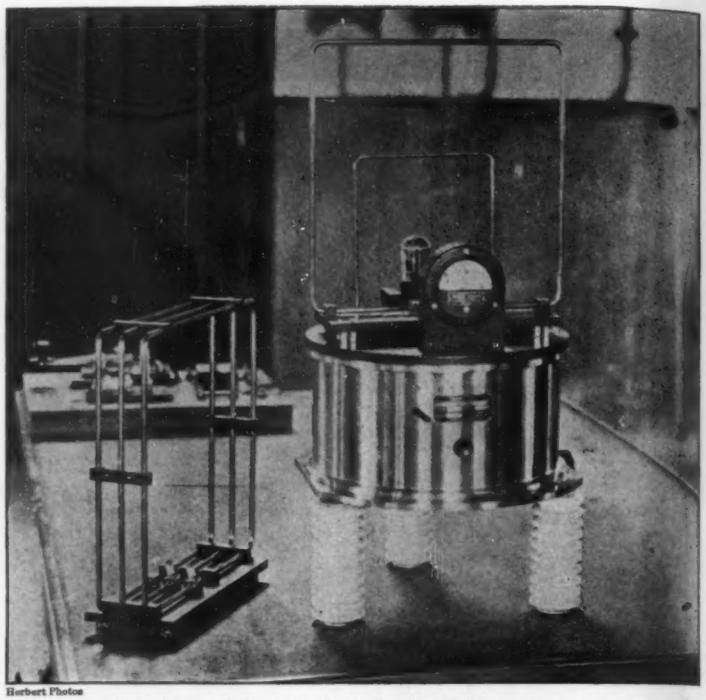
"I have carried out some experiments with telephony and have succeeded in constructing a new modulator, which does not employ transformers. I have carried out regular broadcasting to our colonies, where small receivers have been erected. I have a patent pending at home, and the Government has purchased my idea for use in Greenland."

Parts of the special broadcasts from KDKA and its sister stations are rebroadcast by Holten-Moeller in an attempt to reach Iceland. Mr. Wendt has received no advice as to the success of this.

Secrecy of Radio

IT is extremely doubtful if arrangements can ever be achieved in the direction of making radio communication secret to such an extent that it will not in time be possible

(Continued on page 354)



Herbert Photos

Engineers of the Marconi Company have developed this wavemeter to accurately measure the length of Hertzian waves. Designed especially for short-wave work, the instrument is used with the "beam" system of transmission

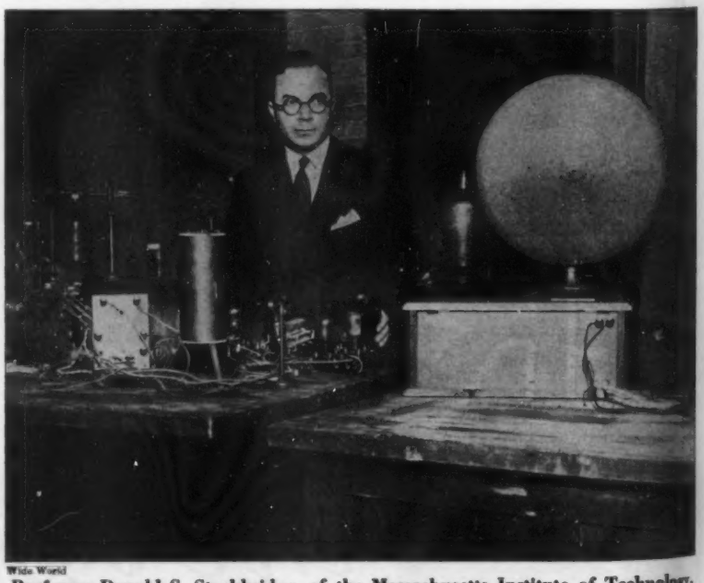
for the enemy to make provisions to decipher it, according to Captain R. H. Ranger of the Signal Corps Reserve.

"The only safeguard is to make such arrangements that one side will always have the other side at least a day behind in his solution of secret transmission," said Captain Ranger. "Thus the information received will be ineffective according to its delay in deciphering. This is, of course, approximately the same situation which exists with all cipher work today. It does seem that it may be possible to carry this to such an extent that the accuracies and speed required for the deciphering work would hardly justify the effort. As with military battle-tactics, the offensive would have the advantage. In this case, each side will be engaged with making their own communications as effective as possible, as quickly as possible, and would have the advantage over those who are depending upon their astuteness in following the shifts of the other side for success. In other words, success in these directions at least will go to the one who jumps ahead of the other."

6,500,000 Sets in United States

THERE are 6,500,000 radio receivers in operation throughout the United States today, compared with 60,000 in 1922, and the audience listening in today is about 26,000,000 as against 75,000 auditors in 1922, according to a survey made by *Radio Retailing* from sources said to be as authentic and accurate as it is possible to obtain. The large increase in the audience is attributed to the fact that loudspeakers are generally used today, instead of headphones, so that the entire family can enjoy the etherial entertainment.

Money spent in the purchase of radio sets and accessories during 1926 is estimated at 506,000,000 dollars as compared with 60,000 dollars spent in 1922. The total expenditure for the five-year period from 1922 to 1926, inclusive of sets and accessories, is placed at 1,490,000,000 dollars.



Wide World

Professor Donald S. Stockbridge, of the Massachusetts Institute of Technology, with his apparatus that, it is said, makes possible the transmission of sounds and motion pictures over an invisible beam of light. The pictures become visible when thrown on a fluorescent screen

Copyright Harris & Ewing

Senator C. C. Dill and Representative Wallace H. White, sponsors of the latest radio bill, holding an impromptu radio concert on the steps of the Capitol, at Washington. The committee provided for by the new bill are now organizing for the relief of the broadcasting situation

The increase in the use of sets on farms shows a tremendous jump from 10,000 in 1922 to 1,350,000 in 1926 at the close of the year. Exports in radio apparatus increased from 2,800,000 dollars in 1922 to 8,500,000 dollars at the close of 1926.

The saturation comparison with other industries to date is as follows: number of homes in the United States 26,800,000; phonographs, 11,000,000; passenger automobiles, 18,000,000; telephones, 17,000,000; homes wired for electricity, 15,900,000; farms, 6,370,000; homes without radio sets, 20,300,000. The radio saturation totals 24 percent, showing that more than three-quarters of the country is still a potential market for broadcast receivers and the necessary accessories.

A census of radio manufacturers reveals 2,550; wholesalers and distributors, 985, and retailers, who carry a complete stock of sets and accessories, 29,000. During 1922 there were 8,500 dealers; the peak was reached in 1924 when there were 45,000, but since that time they have been reduced so that 29,000 was the number of dealers in the United States when 1927 arrived.

Radio in England

THE radio market of England is in a healthy condition and promises a marked growth, according to W. A. Bartlett, Managing Director of Brandes, Ltd., London.

"The average American's conception of England being a land of crystal receivers and earphones is out of date," said Mr. Bartlett. "Approximately 90 percent of the receivers now use from one to six tubes. The market for tube sets is expected to grow rapidly during the next few years for two reasons. The industrial situation which has been serious, is improving, and the recent re-allocation of wavelengths made at the Geneva conference has prevented chaos. A two-tube set will tune in 20 stations very nicely in most instances, and a six-tube set can get 230 stations. The desire for reception of distant stations is not very general any more. The broadcast wave-band is the same as in America with the exception of Daventry, which is using the 1,600 meter channel."

Broadcasting Sounds of the Locomotive

THE impresario of WGY has made a study of the sounds of a train so that they can be produced so faithfully that auditors many miles away feel that they are listening to the passing of a steam-engine drawn train.

A real locomotive bell and a creditable whistle were readily produced. To these were added boards covered with sandpaper which, when rubbed one against the other, produced what may be described as the "chug-chug" of the engine. A flour sieve helped to define the sharp sound first heard as the engine starts to puff.

Then came the problems of producing the roar of the passing train and the pounding or bumping of the wheels on uneven track.

Harris & Ewing

Radio room on the *Modoc*, one of the ice-patrol cutters, which is one of the most complete floating radio stations in existence. The ship carries four transmitters and four different receivers, together with all accessories

Underwood & Underwood

The existence of the Heaviside layer, which supposedly reflects radio waves back to the surface of the earth when they reach a point about 100 miles high, has been verified, it is said, by Drs. G. Breit and M. A. Tuve, at the Carnegie Institute in Washington, D. C., shown above

A metal panel five feet long and an eighth of an inch thick was decided upon as the road bed. A couple of youngsters on roller skates speeding over the uneven surface of the sidewalk suggested the rolling stock and a pair of roller skates was utilized as a train.

In the first rehearsal, Russell Hoff, chief of the control rooms crew suggested that a couple of heavy cords be stretched over the metal panel. As the roller skates passed over the panel one could not tell the sound from that of a train bumping over uneven rails. The volume of sound was regulated in the control room. The listener first heard the distant whistle and the muffled roar. Each second the control-room crew built up the volume until the sound simulated that of a heavy train thundering past a little country railway station. An added effect, familiar to those who live near passing trains, was the rattling of window glass.

Six people are required to produce the train effect, one to whistle, one to "chug," one to operate the roller skates, one to make windows rattle, another to sound the bell and the sixth, the control room operator, to control the sound volume.

The best recipe for a fast train, then, is: two short pieces of wood covered with sandpaper, a flour sieve, a pair of roller skates, a metal panel, a whistle, a bell and two pieces of heavy cord.

Call Letters

CALL letters assigned to the United States in the international system are three- and four-letter combinations beginning with the letter N, all those beginning with the letter W, and all combinations from KDA to KZZ, inclusive.

All combinations beginning with the letter N are reserved for government stations, and in addition, the combinations from WUA to WVZ and WXA to WZZ are reserved for stations of the United States Army. During the war the combinations of three letters beginning with K, W and N were exhausted, and it was necessary to assign combinations of four letters beginning with K, W and N.

Relation of Temperature to Signal Strength

THE relationship between radio signal strength and temperature, as observed in special tests, has been reported by L. W. Austin and I. J. Wymore to the Institute of Radio Engineers.

"During the cold waves of January, 1924, a marked increase in the strength of signals from the transatlantic radio stations at Tuckerton, New Jersey, and New Brunswick, New Jersey, was observed in Washington," says the report. "This was considered remarkable as the commonly accepted ideas regarding the earth's atmosphere indicate that there should be no connection between the weather near the ground and conditions at higher altitudes where the main variations in signal strength are supposed to be produced."

It was found that transmission from stations at moderate distances was better fitted for the study of possible meteorological influences than the transmission of distant stations. This is because, the relative variations in signal field-intensity being approximately the same, weather conditions in the latter case cannot be expected to be uniform over the whole signal path.

Continued daily observations of the two stations, extending over more than two years, appear to prove that there is some kind of inverse relationship between signal strength and local temperature, though this temperature effect is often masked by other influences.

The tests revealed that the average signals of February are twice as strong as those of July. The day-by-day relationship is less satisfactory, varying from fairly clear in the winter months to obscure in midsummer.

The report says, "That the variations in signal strength are actually produced in the upper atmosphere and not in the portion of the wave traveling along the ground seems to be proved by the fact that in the region involved there is no definite change in signal intensity, due to long-continued rains or droughts, or to the presence or absence of snow, for the higher wavelengths. In addition, it is hardly conceivable that the rapid intensity changes observed during cold waves could be due to the penetration of frost in the ground, which is of necessity a gradual process."

Abyssinian Expedition Uses Short Waves

AMATEUR radio operators who have picked up messages on short waves from Arctic explorers and from the Dyott expedition now following Theodore Roosevelt's trail down the River of Doubt through the jungles of Brazil, are likely to hear dispatches from Gordon MacCreagh, now exploring in Abyssinia.

Some of the equipment carried by the expedition is that which Commander Richard E. Byrd took in his airplane on the successful flight over the North Pole. This

apparatus consisted of a broadcast receiver and a CR-18 short-wave set designed by A. H. Grebe and Company, Inc. The short-wave transmitting equipment used by the expedition is of British design.

Radio Replaces Wires Along the Magdalena

Two American engineers are engaged now in measuring the penetrating effect of a 500-watt radio-telephone transmitter at Puerto Mosquitos, in Colombia, South America, 200 miles inland along the Magdalena River. They are L. C. Hollands and H. V. Johnson of Pittsburgh, engineers for the Westinghouse Electric and Manufacturing Company. The transmitter is owned by the Andian National Corporation, owner of a pipeline. Nine pumping stations are situated at 45-mile intervals between the oil fields in the interior of Colombia and Barranquilla, a port on the Caribbean Sea, and the transmitter is designed to maintain communication between them.

It is important that each station be kept informed of the pumping activities of its neighbors, because closing the valve at one station without informing the next pumper would be certain to result in a burst pipe with consequent expensive delay.

The present telephone line, however, stretched at random as it is through the dense equatorial foliage, is exposed to the fury of the jungle storms; and with trees continually falling across the line, communication often has been interrupted. The oil company's officials decided there was too much time and money lost through the breaks in the line. Therefore they called in radio engineers to see if a continuous system of radio intercommunication could be installed, which would eliminate the uncertainty of the wire lines.

The Heavens in May

By Professor Henry Norris Russell, Ph. D.

At 11 o'clock: May 7.
At 10½ o'clock: May 15.
At 10 o'clock: May 22.

At 9 o'clock: June 7.
At 8½ o'clock: June 14.
At 8 o'clock: June 22.

At 9½ o'clock: May 30

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on May 7, etc.

NIGHT SKY: MAY AND JUNE

The Heavens

THIS month we find Arcturus high in the South, with Spica lower on the right, and Antares still below and to the left. Deep on the southern horizon and nearly below Spica, observers in the latitude of Florida and farther south may see the Southern Cross.

The tangled mass of Ophiuchus and Serpens fills the southeastern sky. Aquila is rising due east, while Cygnus and Lyra are low in the northeast; Hercules and Corona are high above them, Draco and Ursa Minor far up in the north and Ursa Major in the northwest, while Cassiopeia grazes the horizon.

Of the brilliant winter constellations only Auriga and Gemini remain, and these are setting. Leo and Hydra are the principal groups in the dullish southwestern sky.

The Planets

Mercury is a morning star when May begins, but is too near the sun to be easily seen. He draws closer, and on the 20th passes into the evening sky, not to be seen there, however, until the next month. Venus is an evening star, far north of the celestial equator, very bright and extremely conspicuous. She remains in sight until after 10 P.M. Mars is an evening star too, in Gemini, and sets about an hour later than Venus. Jupiter is a morning star in Pisces, and rises about 2:30 A.M. in the middle of the month. Saturn is in Scorpio and comes to opposition on the 26th. He is conspicuous to the eye all night long but is too far south and too low in the sky for the best telescopic observation. Uranus is in Pisces, about 5 degrees east of Jupiter, and is observable in the morning. Neptune is in Leo. He is in quadrature east of the sun on the 16th, and can be observed telescopically in the evening. He is not visible with the naked eye.

The moon is new at 8 A.M. on the first; in her first quarter at 10 A.M. on the 8th; full at 2 P.M. on the 16th; in her last quarter at 1 A.M. on the 24th; and new once more at 4 P.M. on the 30th. She is nearest the earth on the 4th, and farthest away on the 18th. During the month she passes by Venus on the 4th, Mars on the 5th, Neptune on the 9th, Saturn on the 17th, Jupiter on the 25th, Uranus on the 26th, and Mercury on the 31st.

Assistance Wanted

Here is an opportunity for some of the readers of this magazine to render a real service to one of the large universities of this country. In the letter reproduced below, Prof. Grant asks for your help. Will you give it to him? You can communicate directly with Prof. Grant at the address given, and if you do so, you may be sure of our thanks in advance.

Editor, Scientific American:

We are making a study of equipment for Industrial Arts courses in secondary schools and are especially anxious to secure data from reliable and experienced individuals who carry on scientific hobbies in their own shops.

We should greatly appreciate your cooperation and suggestions regarding this problem and would particularly like to know if you could put us in touch with some of your mechanically inclined readers, with the view of securing their opinions concerning tools and machines that should have a place in schools.

We shall be glad of any assistance you can render.

Gordon Grant, Instructor,
Industrial Arts Department,
Teachers College,
Columbia University,
New York City.

High-Speed Turbine

Truly this century has been said to be one of speed. No sooner is one record set, than it is broken. The supercharger rotating element was said to be the fastest revolving thing known. Now comes the report of something faster.

Editor, Scientific American:

In the Scientific American for September, 1926, in connection with an article on the special equipment used by Lieutenant John MacReady, I noticed the statement that a certain piece of equipment contains "What is said to be the fastest revolving wheel in the world." This was said to revolve at a speed of 40,000 revolutions a minute.

I have read, on what authority I do not know, that the discovery of a new steel alloy has been announced by Sir Robert Hadfield of Sheffield, England, which is said to be able to withstand so high a temperature that a gas turbine has been constructed to run at a speed of 55,000 revolutions a minute at a working temperature of 1,650 degrees, Fahrenheit.

A. P. Taylor,
Dean of General Science,
College of Agriculture and Mechanic Arts,
New Mexico.

"Buried Secrets of the Holy Land"

Under the above title, we published an article in our February, 1927, issue. Since that publication, we have received two letters challenging the accuracy of some of the statements made in that article. In fairness to all, we are glad to publish these letters.

Editor, Scientific American:

My attention has been called to the fact that in the very interesting article by Mr. Shepstone, "Buried Secrets of the Holy Land," pages 98-100, of the February issue, he refers to the excavations made at Kirjath Sepher, and names only Dr. Albright, Director of the American School in Jerusalem, as concerned in that excavation. In matter of fact, the affair was a joint enterprise of the Xenia Theological Seminary and the American School in Jerusalem, the head of the expedition being President M. G. Kyle, of the Xenia Seminary, St. Louis, Missouri, Dr. Albright acting as Archeological Adviser.

Representing, as I do, the American School in this country, I am very loth to have Dr. Kyle's part in the excavation ignored and I should be glad if you could make this correction. It was through Dr. Kyle's enterprise that the money for this excavation was raised and the plans for its carrying out were conducted.

James A. Montgomery,
President, American School of Oriental Research.

Editor, Scientific American:

My attention has been called to the interesting article in your February number, entitled "Buried Secrets of the Holy Land," by Mr. Harold J. Shepstone. A number of errors and omissions seem to have slipped by the author.

The present home of the Palestine Museum in Jerusalem is in a small rented building, erected long before the war, and called the "Way House." This structure was not built after the war, as stated in the text accompanying the first cut. The absence of a suitable museum building is, in fact, the most serious lack in Palestinian archeology today, since the half of all objects excavated which becomes the property of the government cannot be properly housed under present conditions.

The American School of Oriental Research, of which the writer has been director since 1920, was founded in 1900, twenty years before the British School of Archeology in Jerusalem. There is also a French School of Archeology, founded since the war, but incorporating the Dominican Biblical School, which counts among its professors Père L. H. Vincent, the foremost living authority on Palestinian archeology. The German School, founded before the war, has resumed its work since 1924, and is doing excellent work. The Hebrew University of Jerusalem is also engaged in important work, taking the place of the Jewish Palestine Exploration Society.

Without delaying over numerous minor inaccuracies in the account of the recent excavations, some corrections and additions may be made. It should be particularly stressed that the excavation of Tell Beit Mirsim, probably ancient Kirjath Sepher, south of Hebron, was carried on jointly by the American School and by Xenia Theological Seminary, St. Louis, whose President, Dr. M. G. Kyle, provided the funds for the undertaking and collaborated in the actual work of excavation. The excavations mentioned immediately afterwards, as carried on under the direction of

Dean W. F. Badè of the Pacific School of Religion (not the University of California, as stated), is the first campaign at Tell en-Nasbeh, identified by some scholars with ancient Mizpah. This important work is now being resumed by Dr. Badè.

The excavation of Shechem, near modern Nablus, by a joint German-Dutch-American expedition, under the direction of Professor Sellin of the University of Berlin, is curiously misrepresented. The ruins of the palace of Ahab were not found here but at Samaria, excavated in part, before the war, by Harvard University. Shechem is not so old as Jerusalem, a fact proved conclusively by the excavations on these two sites. The American support of this expedition, which is securing very important results, comes through Bishop Du Bose of the Southern Methodist Church. In the account of the excavations at Beth-shan it should be stated that the work is being carried on under the auspices of the University of Pennsylvania Museum in Philadelphia.

The Austrian excavations at Taanach, mentioned in Mr. Shepstone's article, as under way now, were carried on a quarter of a century ago, and have never been resumed, although Professor Sellin made some important discoveries there. The excavations at Megiddo, mentioned in the same connection, are being continued under the auspices of the University of Chicago, whose Oriental Institute, under the direction of Professor J. A. Breasted, is now conducting several archeological undertakings of great significance, with funds given by John D. Rockefeller, Jr. The Field Director of the Megiddo Expedition, Dr. Clarence S. Fisher, is one of the foremost living field archeologists, who divides with Professor George A. Reisner of Harvard the merit of having placed field archeology on a sound scientific basis. It is a pity that amateurish sensationalism and publicity of the Tut-ankh-amon variety are obscuring this fact and threatening to make archeology somewhat of a byword in scientific circles.

Very respectfully yours,
W. F. Albright.
Director, American School of Oriental Research in Jerusalem.
American address: Care Professor G. A. Barton, University of Pennsylvania, Pa.

Two Heads Are Better Than One

In Denver, two amateur enthusiasts have constructed a telescope of the Springfield type. Their use of a drive-shaft housing chosen from the junk pile of an automobile garage for a pedestal is most commendable. Mr. Cedric Kaub, one of the joint constructors, writes as follows:

Editor, Scientific American:

Knowing your interest in the subject, I enclose a photograph of the telescope that Mr. Richard Haberl and I have built, following the instructions in the Scientific American, and in the Scientific American book, "Amateur Telescope Making."

We are delighted with the results obtained so far, and are looking forward to even better results when we get everything adjusted to our full satisfaction. We expect to have a great many pleasant evenings with the telescope.

We had quite a struggle with the mirror but it finally turned out O.K., thanks to the kind assistance of Mr. Porter, Mr. Pierce and yourself. It took about seven months, two and three nights a week.

The mounting is of the Springfield type, castings and working parts of brass from patterns designed and made by Mr. Haberl. The tube is enameled galvanized iron. The pedestal is a

The drive-shaft housing from an old automobile furnished the pedestal of this home-constructed telescope

Buick drive-shaft housing, which was ideal for our purpose.

The mirror is six inches in diameter and is removable from the telescope. The latter is permanently mounted on the roof of the shop in the rear of Mr. Haberl's house, which gives us a much larger range of view than would a mounting on the ground.

Mr. Haberl designed several new kinks by which we were able to divide the hour circle and the declination circle on a lathe, and an improvement on the slow motion; also a method of cutting the template which gives a smooth and true curve. If any of your readers are interested we will be glad to furnish details.

Cedric Kaub.

Pictograph

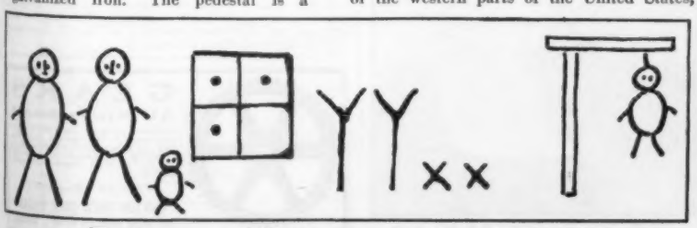
Mr. S. Leonard Bastin of Bournemouth, England, sends us in the following note, containing a kind of puzzle. The answer, which he appends, is obvious but interesting. After all, this is nothing but pictographic writing. The American Indians have used it since time out of mind, and various savage tribes the world over have developed it to a degree fully as comprehensive as did the Englishman of an illiterate century:

A century ago a great many people in England could neither read nor write. In this connection a strange document has come into the hands of the Antiquarian Society of Blackburn, England. This paper, which is just a hundred years old, shows how a local builder, who could not read or write, made out his bill. The statement is in the form of little sketches which are here reproduced. Translated into everyday English the bill reads: "To two men and a boy for three-quarters of a day, using two hods of mortar—ten shillings." Figure it out.

When the bill was paid the manner of showing that the account was settled was certainly strange: the final picture is that of a man hanging from a gallows! One could hardly imagine a more impressive way of indicating a "closed account."

An Arch of Petrified Logs

We have all heard of the petrified forests of the western parts of the United States,



Would you pay a bill that was rendered in this manner?

Logs of petrified wood furnished material for this unique arch

but how many of us know of the purposes to which the logs of these forests can be put? The following letter gives an insight on this subject, and in particular stresses one of the decorative possibilities of these stone-like age-old trees.

Editor, Scientific American:

A unique arch or marker built of pieces of petrified logs from Arizona, unlike any other monument or arch in the world, has been erected at the entrance of Woodlawn cemetery at Sioux Falls, South Dakota. The late United States Senator R. F. Pettigrew, who conceived the idea, expressed his belief that some day this arch will be as famous as the Taj Mahal, the tomb in northern India.

The base of the monument is made of quartzite, quarried in the vicinity of Sioux Falls. At each end are columns made of pieces of logs set on top of each other. Between these, the face of the monument is composed of cross sections of petrified logs, highly polished, the unusual colorings giving a striking appearance. The lintel bearing the word "Woodlawn" on the front is a large, polished piece of Sioux Falls granite, which was part of the South Dakota exhibit at the World's Fair in Chicago. "South Dakota" is cut on the back of this stone.

The pieces of petrified logs of which the monument was built, were found near the Rio Virgin river, north of the Grand Canyon, in a region which is now a government reservation. Before it was taken over by the government, many of the logs were crushed for abrasive purposes. Large quantities were brought to Sioux Falls to be polished and shipped to all parts of the world. Senator Pettigrew purchased all the remaining logs and has used some of them in building a unique addition to his home and museum, as well as for the cemetery arch.

The material in these logs will cut glass. It is said to be pure silica, with varied and beautiful colorings of iron. Some of these pieces of logs were from trees 200 feet tall. They were taken from a layer of reddish sandstone in which they were formed under 400 feet of solid rock, and found where erosion had cut through the rock in ravines.

The arch creates much interest, and many people going through Sioux Falls stop to inspect it. The base is nearly 20 feet long, and the arch stands more than 20 feet high. It is two feet thick at the base.

R. W. Horn,
Sioux Falls, South Dakota.

Congratulations

One of our associate editors who conducts the department, "Commercial Property News," unblushingly suggested that we publish the letter which follows. Since this is a particularly sweet-scented bouquet, we do not blame him.

Editor, Scientific American:

I believe when a man does well it is in order to tell him so. The November and December issues of the Scientific American are evidence that your department is well covered and ably edited.

It is a fact that legal information regarding patents, and a patentee's legal rights are more valuable to the inventor and patentee than any other information he can get. The department mentioned is in my opinion, exactly what the majority of the readers of your magazine need and want.

Yours very truly,
P. L. Howlett,
Brownwood, Texas.

Reliability

Every once in a while one of our older readers steps up and hands us a pat on the back that makes us feel rather good and causes us to renew once more our resolve to preserve the authenticity of all articles published. Here is a comment on one of our editorials which shows the difference between reactions to "popular" news items and to the presentation of sound facts with the "frills" left out.

Editor, Scientific American:

The Scientific American is to be congratulated on its editorial occupying the center of page 412 of the December, 1926 issue, captioned "Steel Buildings Survive Tornado." Sensationalism in newspaper reports so swamp facts as to leave nothing in the mind of the reader but the thought of disaster, while, as your editorial goes to show, all so-called disasters carry constructive lessons. It is a pity that greater publicity is not given to the highly educational features which could be deduced by the popular press in reporting such news as the Florida disturbances.

I remember as a very small boy when the first newspaper reports told of the Johnstown flood. Consternation spread over the land and after perusing the reports, an uncle of mine, in whose file of the Scientific American I was wont to revel, remarked, "We will wait until the Scientific American comes out and we will get the straight of it," which we did—in an understandable manner.

F. R. Maulsby,
San Francisco,
California.

Another Humming Bird

Another reader of our magazine has had the experience of keeping a humming bird for a pet. His letter follows and the photograph that he sent is reproduced in these columns.

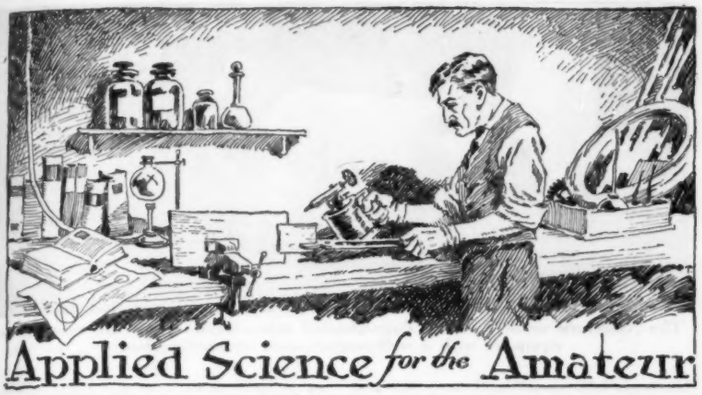
Editor, Scientific American:

I read with much interest the article in the December issue of Scientific American regarding a pet humming bird. I am sending a photograph of one that I had for a pet in 1913. This picture and a description appeared in *Bird-Lore* for October, 1915. I donated the plate from which this picture was made to the Audubon Society of New York.

Trusting this may be of interest to you, I am,

Yours very truly,
A. E. MacGalliard,
Granite City, Illinois.

A tame humming bird being fed



Applied Science for the Amateur

A department devoted to the presentation of useful ideas wherein will be found material of practical value for those who are mechanically inclined

Conducted by A. P. Peck

True Horizontal Boring

WHEN boring horizontal holes, it is easy to keep the bit at right-angles to the work in the horizontal plane, but difficult to keep it at right-angles in a vertical plane. This simple little trick for eliminating this trouble will be found very effective. A large iron washer is slipped over the shank of the bit before it is inserted in the chuck, and the hole is started. The washer is placed about half way between the chuck and the expanded part of the bit, and then the boring is continued. If the hole is progressing horizontally, the washer will remain in the same position on the bit, but if the hole is slanting downward, the washer will slowly travel toward the work. On the other hand, if the hole is slanting upward, the washer will travel toward the chuck. Merely by watching the washer and the horizontal angle of the bit, the hole can be bored true.—*Contributed by C. L. Wooley.*

Waterproofing Fishing Lines

THOSE who are at all familiar with the most elementary chemistry, know that one of the simplest ways to waterproof an object is to coat it with wax. While this general rule is very good, still there will arise occasions when the application of the wax is not found to be an easy matter. Just such an instance comes up in the waterproofing of fishing lines. One ardent sportsman has solved the problem in a simple manner, and, under the initials J. R. P., he tells of his system in *Field and Stream*. The accompanying drawing shows the method used, and J. R. P. tells of it as follows:

"If you are a user of soft braided silk bait-casting lines you will not be interested in this. But if you prefer the waterproof, hard-braided variety, it is well to know how to keep your lines in condition to get the maximum service from them.

"The waterproofing on a hard-braided bait-casting line is not a permanent proposition like the enameled dressing on a fly line. Ordinarily paraffine is used. Its purpose is two-fold; to render the line smooth so it runs freely through the guides, and to reduce wear and add longer life.

"This paraffine dressing wears out quickly when much casting is done, but it can be replaced easily by the method shown in the diagram. The outside pan is half filled with water and the inside and smaller receptacle contains paraffine.

"Place on the gas stove and heat over a slow fire until the water becomes hot enough to melt the paraffine. Do not boil the water, for if the wax becomes too hot it will injure your line.

"When the paraffine is in a liquid state, thread the end of your line through the eye of a dipsey sinker and drop it into the inner pan. You can strip your line off the reel or unwind it from a spool which revolves on a nail as in the drawing. The rest is simple. Just draw the line through a cloth to wipe off the excess paraffine, drop the line in coils to the floor and you're done."

A fishing line waterproofed by this method will give long service

Preparing Photographic Prints

ONE problem of the amateur who does his own printing, is the production of prints that will lie flat without curl or wrinkle. To those who do their printing on glossy-surfaced papers, ferrotyping offers the simplest solution, but it is surprising how many amateurs fail to avail themselves of this process, assuming that it is difficult or complicated, while as a matter of fact, it is simplicity itself. The only expenditure required is for a small-size ferrotype plate, which may be purchased for a few cents at any photographic supply store. A small rubber-covered roller will also be necessary, if that item is not already included in your equipment.

The prints, after the regular washing, are simply placed face down upon the enameled surface of the plate, and "squeegeed" or rolled into perfect contact with it, using considerable pressure, which must be increased for double-weight papers or post cards. After thorough drying, which may be hastened by placing the plate in a current of warm air, the prints will come loose, or may be peeled from the surface, when they will be found to be perfectly smooth and possessed of a high, mirror-like gloss which will equal that attained by the professional photographer.

The velvet-surface papers, such as are commonly used by the amateur, may be manipulated in the following manner. After removing from the final wash water, place face down on soft cotton cloths or towels to dry. They will curl while drying, but may then be made perfectly smooth by running a clean, fairly hot flat-iron quickly over the back of prints, after they are thoroughly dry. For this purpose, they should be placed face down on a clean sheet of paper, laid on a cloth-covered ironing-board or table.

By this method, and also by ferrotyping, the finished prints or post cards will be

The American version of the four-wheeled motorcycle. Here the machine is equipped with a well-proportioned stream-line body

left beautifully smooth and even, but with a curl toward the emulsion or picture side. This may be permanently removed, or they may be given a slight backward curl, by the application of heat while they are held evenly rolled in the opposite direction. This is best accomplished by rolling around a mailing tube of a slightly greater circumference than the over-all length of prints. Several may be done at the same time, if placed with their backs to the tube and on top of each other, and held tightly in place by one or two heavy elastic bands. A few seconds exposure over a hot stove or any source of dry heat, avoiding all open flame, will give the desired results.—*Contributed by Harold B. Phillips.*

An American Four-Wheeled Motorcycle

AFTER reading the description in our January, 1927, issue, of the French motorcycle that was equipped with two small balance wheels, Mr. P. A. Benedict, of Hollywood, California, felt it necessary to let us know that he had built a similar but far more improved machine of this type, and that he did this work over two years ago. Because of the unusual features of this machine, and feeling that photographs of it will interest our mechanically-inclined readers, we present the following description, and reproduce in these columns two photographs supplied by Mr. Benedict.

One of the illustrations shows the machine without an enclosing body. This serves to make plain the various unique mechanical features. Chief among these must be mentioned the spring suspension and the steering wheel which, operated in the same manner as the wheel of an automobile, replaces the regulation handle-bars of the motorcycle. These can be plainly seen in the photograph and should furnish sufficient information to any of our readers who are desirous of attempting to build a similar machine.

The other photograph shows how a stream-line body was applied to the "chassis." This gives the machine a still more unusual appearance and at the same time serves to protect the mechanism from the elements.

The builder of this machine states that it can be handled in traffic with the ease of an ordinary motorcycle and that it has the added advantage that the rider need not balance the machine with his feet when coming to a stop. All that need be done is to let down the two small wheels as the machine slows down and it will come to rest in an upright position.

Mr. Benedict informs us that this machine has made quite a reputation for itself in the motion pictures, having been driven by him for "trick" parts in comedy productions.

Lubrication for Taps

DO not make the mistake of using inferior oil when tapping a hole. The tap needs the best there is and the oil used often spells the difference between a good and a bad job.

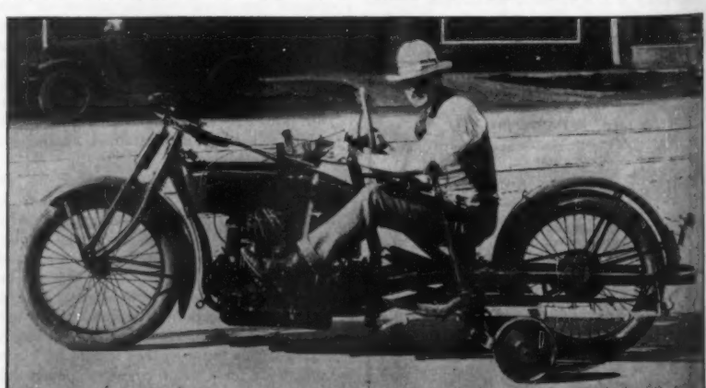
Sperm oil is generally conceded to be the best oil to use on a tapping job but its cost is often prohibitive. The next best is a good grade of lard oil. In fact, it is the oil in common use for such purposes and is generally accepted as the best for all work of this kind. Its cost is higher than other oils but it must be remembered that the job is one where the tap is the shaft and the hole the bearing. Excessive friction is created and the lubricant must both oil and cool the two metals.

So, if you want to keep taps sharp and threads clean, use only the best lard oil obtainable. It will pay in the end.—*Contributed by L. B. Robbins.*

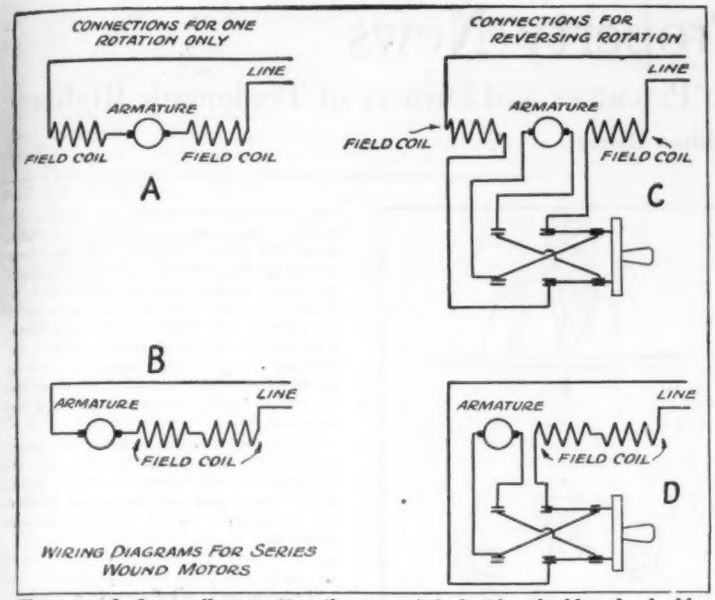
Motor Reversal

SMALL series-wound, direct-current motors are usually not supplied with reversing arrangements. However, it is often found desirable to reverse the direction of rotation of such a motor and in this event, the diagrams reproduced in these columns will be of value. A and B show the two general connections for the field coils and the armature. Either of these types lend themselves to the use of a double-pole, double-throw switch for reversal. The connections for this purpose are shown in the diagrams C and D. The connections shown in C are for a motor that was originally wired as at A, while those in D are for a motor wired as in B.

This use of a double-pole, double-throw switch is one that is well worth remember-



This shows the mechanical parts of the motorcycle equipped with two small wheels which make the machine easy to handle, especially in traffic



The reversal of a small motor is easily accomplished with a double-pole, double-throw switch wired in the circuit as illustrated here

ing. It can often be applied to other usages aside from the reversing of motors. Where it is desirable to have the direction of current flow under control at all times, a switch with the poles wired as shown will be of service.

Compasses in Electrical Work

TWO practical applications of the fundamental principles of electricity and magnetism were recently described in *Electrical Merchandising*. Believing them to be worthy of wide notice, we reprint the two items and reproduce two drawings in these columns.

Locating Wires Under Floors

The unsatisfactory method of locating wires in a floor by hammering to a man below is replaced by H. Rosenhaft of Brooklyn, New York, with the use of a magnet and compass.

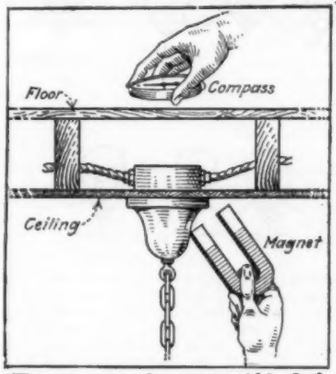
One man holds a horseshoe magnet on the ceiling near the fixture in the room below. The other man takes a small pocket compass and runs it over the center of floor in the room above. By the action of the compass, the exact location of the magnet below is soon determined. This method very often saves the useless ripping up of several pieces of flooring.

Finding Ground in Conduit

A ground in a conduit may be quickly located by the use of direct current and a compass connected as shown in the accompanying diagram.

Send a direct current of two or three amperes through the circuit made by the grounded wire and the conduit. Connect in this circuit a double-pole, double-throw switch which can be operated by hand about fifteen times a minute and will cause an alternating current to flow. This reversing of the current can be done by a commutator driven slowly by a small motor, thus eliminating the need of two men for the test.

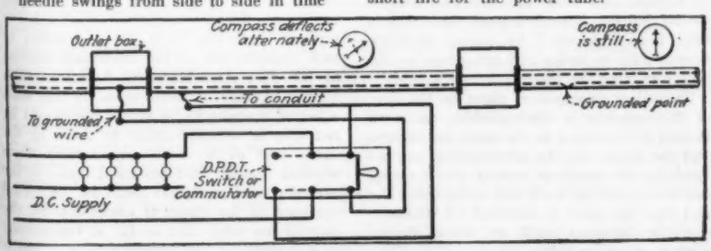
At various intervals, a pocket compass should be held close to the conduit. It will be noted that the compass needle swings from side to side in time with the reversing current. When the compass is carried past the point of the ground, no deflection will be made. By bringing the compass back, the exact location of the ground may be found.



The magnet and compass aid in finding wires between ceiling and floor

Protecting Power Tubes

MANY power tubes in radio receiving sets are operated from raw alternating current supplied by a secondary on the "B" battery eliminator transformer, or from a separate transformer. Radio set users are apt to rely too much on the stated voltage of the secondary in either case, and as a result, many power tubes are ruined. Because of line-voltage fluctuations, the filament voltage applied to the power tube will often vary through quite wide limits. Therefore it is always to be recommended that an amperite or self-adjusting rheostat be placed in the circuit. An ordinary rheostat will not serve properly in this case because the same trouble will still be present. Manual control of the voltage will not suffice because the operator cannot anticipate line-voltage fluctuations. The self-adjusting rheostat will do this, however, and will often mean the difference between long life and short life for the power tube.



When one of the wires in a conduit grounds to the metal covering, the method illustrated will quickly locate the defective point

Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Conducted by Milton Wright

Changes in Patent Law

CHANGES in patent procedure which have been the subject of discussion for more than a quarter of a century, are effected by a recent amendment to the law adopted by both houses of Congress and signed by the President. These changes are said to constitute one of the greatest steps in simplifying procedure in patent practice which has been taken in 60 years.

An act amending Section 4900 of the Revised Statutes requires patent owners to mark their devices "Patent Number....." instead of "Patented (with date)" as heretofore. This, according to Patent Commissioner Robertson, greatly simplifies the matter of obtaining data at the Patent Office. Sometimes hundreds of patents are granted on the same day, and heretofore all of these would have to be looked over in order to find the desired information. By requiring, however, that the device be marked with the patent number instead of the date, the search for information will be considerably expedited.

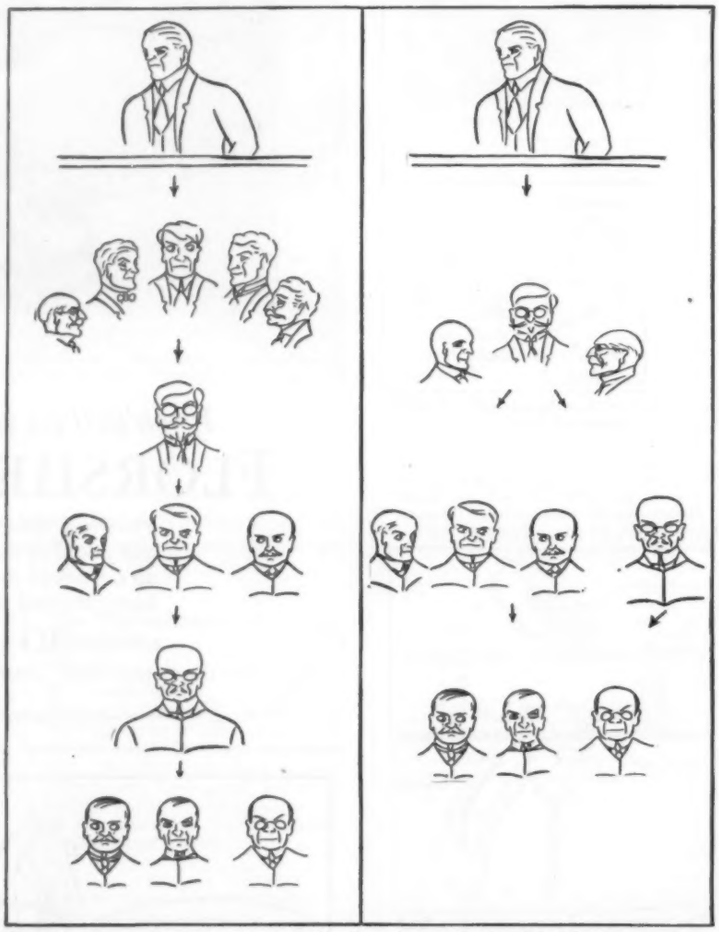
Another of the recent changes is the increase of the Board of Examiners-in-Chief from five members to six. These, according to the Commissioner, will quicken the work of the Board. The same act also provides that the fees for obtaining patents shall be the same as heretofore, except that in cases where there are more than 20 claims, the fee is increased one dollar for each claim in excess of 20, as originally presented in the application or as present in the issued patent, according to the present understanding of the Patent Office, as we have been informed unofficially. These fees are payable with the filing of the application. When the patent is granted, an extra charge of one dollar for each claim in excess of 20 is made on the printing and filing fee. We understand that there is no such extra fee of one dollar for claims, in excess of 20, submitted and cancelled during the prosecution of the application.

Another act is explained by the Commissioner as follows:

> "Where a suit is brought for the infringement of a patent and the patent is held valid and infringed but it has now expired, an appeal will be permitted to the Circuit Court of Appeals before the ordering of an accounting instead of afterwards. Heretofore, in such case, the parties would have to go through an accounting proceeding, which sometimes costs thousands of dollars; then, if the appellate court reversed the lower court, these accounting proceedings were entirely wasted. By permitting an appeal before ordering an accounting, this objection will be overcome and a saving of thousands of dollars will result."

Various changes are provided by still another act. Among these is a provision that an applicant must respond to an official action or take an appeal within six months instead of within a year as heretofore. If the case is forfeited for non-payment of the second government fee, he must renew it within one year instead of within two years as formerly. By another provision, if the last day for taking any action or paying any fee falls on Sunday or on a legal holiday, the Patent Office may receive the documents or fee on the next succeeding business day.

The same act also provides for a single appeal within the Patent Office. Heretofore there has been an appeal to the Board of Examiners-in-Chief, and a second appeal to the Commissioner. Now, however, a new Board of Appeals is provided, comprising the Commissioner, the two Assistant Commissioners, and the Examiners-in-Chief. Any three members may constitute a quorum.



Procedure on appeals in patent applications is greatly simplified by the new law. The left column above shows the course of an appeal heretofore: (1) the Primary Examiner in the Patent Office, (2) the Board of Examiners-in-Chief, (3) the Patent Commissioner, (4) the Court of Appeals of the District of Columbia, (5) the Federal District Court (on a bill in equity), (6) the Circuit Court of Appeals. The right column shows the procedure under the new law: (1) the Primary Examiner, (2) a quorum of the newly created Board of Appeals, (3) either the Court of Appeals of the District of Columbia or the Federal District Court, (4) the Circuit Court of Appeals

Thus provision is made not only for a single appeal, but it is now possible for two or three appellate boards to be sitting at the same time.

Another important change is made in the procedure regarding appeals to the courts. The applicant heretofore could appeal from the Patent Office to the Court of Appeals of the District of Columbia, and if the decision there was adverse he could then start from the beginning again by filing a bill of complaint in the United States District Court under Section 4915 of the Revised Statutes, and if the decision there was unfavorable he could appeal to the Circuit Court of Appeals. Under the new procedure, he may choose between appealing direct to the Court of Appeals of the District of Columbia, or filing his bill in equity under Section 4915 of the Revised Statutes. Having once elected he cannot do both, as he could heretofore. The right of appeal to the Circuit Court of Appeals is permitted in the same way as formerly.

A Patented Air-Mail Envelope

A SPECIALLY designed envelope is patentable, the examiners-in-chief of the Patent Office declare, in reversing the Primary Examiner's rejection of some of the claims in the patent application of Charles L. Stokes. The invention consisted of red, white and blue bands prominently displayed on the envelope's face. The examiner, in rejecting the claims, cited distinguishing marks on change envelopes, filing wrappers, baseball schedules, ballots and military insignia as well as "Our Army," a book published by Munn and Company in 1919.

"The invention claimed is an envelope for containing matter to be conveyed by special service such as by airplane," say the examiners-in-chief. "It is pointed out that prior to this invention, letters intended to be sent by airplane and where for such transmission special postage has been paid, such letters have been overlooked by postal employes thereby causing delay and annoyance to the person mailing the letter.

"Appellant proposes to place on the face of the envelope a distinguishing mark so located with respect to the space for stamps and the space for the address that anyone handling the envelope cannot avoid seeing the distinguishing mark and recognizing the fact that the letter is intended for transmission by airplane mail or other special method of transmission.

"The references cited by the examiner show distinguishing marks on change envelopes, filing wrappers, baseball schedules, ballots and military insignia. The statement on appeal also refers to mourning envelopes and those having seasonal marks such as Christmas stamps. In the view we take of the matter, none of the references is better if as good as the Taylor patent which is for a change envelope having bands of color on the face and edges thereof to indicate the amount of change contained in each envelope.

"We do not find in the references singly or combined the special location and arrangement of color bands or stripes called for by these claims and the special location and arrangement is not suggested by the references."

Trademark Registration and Infringement

IN a recent article in the *New York Times* an executive of the Trademark Bureau of the Silk Association of America is quoted concerning the difficulty of getting trademarks, the title of the article being, "Trademarks Hard to Get." In this article appeared the following statement:

> "A brand-silk manufacturer, about to market a new weave, chose a name which was to his liking, and subsequently made all the proper inquiries with the Trademark Bureau to find out if such a name had been previously registered. But it appeared there was nothing, among the 20,000 on record with the Bureau, even remotely resembling his choice.
>
> "The manufacturer thereupon proceeded to adopt the name for his own use, had labels designed and printed to be attached to the wrappers of the silk and filed the name with the Bureau to protect it from infringement by others. His advertising was ready to be launched in the trade when he learned quite accidentally that the name he thought of as his trademark was the property of another manufacturer who had been using it for three years, but had not taken the least effort to protect it.
>
> "When the situation was explained to the latter manufacturer, he was quick to sense the risks he was running, and at once sent in all the names he was using, compris.ng a dozen or more, to be recorded with the Bureau.
>
> "The executive went on to add that the risk a manufacturer runs by not registering trade names grows larger every year, because the choice of desirable names narrows down constantly and the chances of duplication are growing greater."

Those interested in trademarks must not get the idea that using a selected and registered mark will relieve one from a charge of infringement. Exclusive ownership of a trademark arises from priority of adoption and use, and registration creates no property right thereto if the registrant was not the first to adopt and use the trademark. There are, however, many advantages and certain rights created by the registration of trademarks under the Federal law in the United States Patent Office, and it is doubtless advantageous for the users of trademarks to register them also with the secretaries of such organizations as the Trademark Bureau of the Silk Association of America. The main advantage, it would seem, is that such a list of trademarks in actual use would be not only a valuable guide to those in the same line of business and inform them whether another had preceded them in the use of a trademark but could be additional evidence of the claim of ownership on the part of the user. But so far as registration is concerned, if one makes use of a trademark or any simulation thereof which has

theretofore been adopted and used by another on the same class of merchandise, he is an infringer whether the prior user has registered or not.

By all means register your trademarks not only with your association but in the United States Patent Office, for the latter registration is regarded by the courts as prima facie proof of ownership. But do not get the idea that if you adopt a trademark in prior use by another, but which has not been registered, you are therefore not an infringer.

Trademarks in Cuba

A NUMBER of American manufacturers, contemplating export to Cuba, have learned to their surprise that the Cuban Trademark Law imposes on them restrictions from which they are free in the United States. In Cuba, they learn, the use of trademarks which have not been registered is punishable by fines ranging from 15 to 135 dollars. Like penalties are provided for persons who apply to another class of merchandise a trademark taken for a certain class of merchandise, as well as for assignees of trademarks who have not recorded the assignments in the Patent Office.

The law bears especially heavily upon the manufacture of gold and silver articles and chemical and pharmaceutical preparations which do not bear trademarks. Unless the chemical and pharmaceutical trademarks are registered in Cuba, the products are subject to confiscation and the user to penalties provided by the Penal Code.

Upon notification that a trademark has been changed or altered from the form in which it was registered, the authorities will cancel it. Cancellation will result, also, from failure to use the mark for one year and a day.

In many instances American manufacturers have found themselves deprived of their rights through failing to recognize the difference in the method of protecting prints and labels in the two countries. When a manufacturer forwards his trademark for deposit in Cuba, he usually neglects to send a certified copy of the registration of his label. The result of this is that, while he secures protection for his trademark, the remainder of his label is unprotected.

Through this neglect any firm in Cuba may nullify the value of the trademark for all practical purposes, for any Cuban firm may register as its trademark all of the printed matter and designs included in the label. In such a case, the American manufacturer may use only the actual trademark—not the rest of the matter on the label. What the American manufacturer should do when he desires protection for his entire label, is to send a certified copy of the registration of his print or label with the certificate of registration of his trademark.

A Patent Library

THE Public Library of Los Angeles maintains a Patents Record Room in its new central library building, for the benefit of inventors, patentees and manufacturers in Southern California. The files constitute the largest collection west of the Mississippi of United States, British, Canadian, Cuban and German records. A photostat department of the library makes copies of drawings and texts of patents at reasonable rates.

The Inventors' Market

IN the January, 1927, issue of the Scientific American there appeared in the Commercial Property News Department a two-paragraph item headed "We Offer Our Services." The editor stated that he was establishing two files, one consisting of names of manufacturers who were looking for inventions along particular lines, and one consisting of a list of inventors who were looking for manufacturers to take over their patents.

The response has been very interesting indeed. As was to be expected, a large number of inventors sent in complete descriptions of their inventions, but even the writer was surprised at the number of manufacturers who responded. We are pleased and a little bit proud to announce that we have put several inventors and manufacturers in touch with each other as a result of a similarity in the inventions in which both were interested. Negotiations are going on between these inventors and manufacturers and presumably, in some cases, will be concluded in a manner satisfactory to both parties.

Among the letters written by manufacturers we quote the following paragraphs:

"We are in a position to use and would like to obtain patents of value on textile machinery for cotton. Our equipment is such that we can handle machinery of medium size up to 1,200 or 1,500 pounds weight. We are not equipped to do pressed-metal work of any sort, although we handle quite a bit of sheet-metal work, using sheets up to three-sixteenths inch thick."

"We are equipped to manufacture all kinds of light metal stampings, making our principal product spectacle cases and jewelry from the raw materials to the finished product entirely in our own factory. Our personnel has great experience in our line, most of them having spent their lives at this work."

"To supplement our business of manufacturing library bookstacks, steel shelving and grey-iron castings for the jobbing trade, we are desirous of developing the manufacture of some article that will require quantity production and can be made in our plant which has facilities for manufacturing light grey-iron castings, fabrication of light structural steel, punching and forming of sheet metal, light machining and baked enameling. We would prefer not to take on the production of anything that will require us to develop additional selling facilities and with that in view would rather work with some existing sales organization or one to be established."

"One of our clients is a large manufacturer of children's vehicles, nursery toys and juvenile furniture made of wood. They are constantly seeking new items for their line.

"Should you come in contact with any individual or company bringing out a new item along these lines, the patentee of which is not financially able to manufacture and market it on a large scale, we should appreciate your having them communicate with us. If their items are suitable, our client will be glad to make a satisfactory royalty arrangement or make an outright purchase of the patent rights."

"This company has been in business for about 25 years, and we manufacture approximately 2,000,000 dollars' worth of lamps per year. We wish to extend our business activities to other lines, preferably along lines not too far removed from lamp making. However, we are willing to listen to any sound proposition and are prepared to finance one which will suit our needs."

"As per your January, 1927, edition, page 76, 'We Offer Our Services,' the writer is taking the liberty of asking if you can put him in touch with anyone that might be able to submit a method or process that will keep eggs in good condition for a period of four to six months. Must be something different from cold storage or water glass. If the method used is in a form of a coating, the material must be colorless so as not to change the original appearance of the egg and the coating must immediately disappear when the egg is put in water."

Our offer to be of service to inventors and manufacturers is still open.

World Wide Ragmen

RAG dealers from all over the world met in Paris recently to draw up regulations for international trade, according to the Department of Commerce. Agreements concluded were submitted to rag interests in this country. At Hamburg, dealers collect rags from all parts of Europe for shipment abroad. In eight months 73,588 metric tons were shipped, of which 46,250 tons came to the United States, to be used for paper and board production.

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15 each; state patent number to insure receipt of desired patent copy.

Electrical Devices

COVER FOR SWITCH BOX.—Applicable to any externally operated box, allowing the box, conduits, and wires to be placed within, and the cover be flush with the wall. Patent 1614542. R. Werden, 414 W. Kansas Ave., Trinidad, Colo.

ELECTRIC WATER HEATER.—Of the immersion type, so constructed that the danger of short circuiting the conducting wires by moisture is impossible under ordinary circumstances. Patent 1615819. L. W. Armstrong, Las Animas, Colo.

PRESSURE-OPERATED CIRCUIT BREAKER.—Which can be used on storage batteries, especially on automobiles, to control current supplied by the charging dynamo, and signaling when a definite point is reached. Patent 1616317. J. N. Hanna, Ordway, Colo.

BURN-IN KNIFE.—Wherein the operating end is electrically heated and so associated with the handle as to permit the same to be cool. Patent 1616544. J. and E. V. Paolicelli, 35 Prospect Ave., Arrochar, S. I., N. Y.

ELECTRIC WATER HEATER.—Having heating elements situated in a normally open circuit, the circuit being closed by the fluid in which the heater is immersed. Patent 1618101. S. W. Malcolm, c/o Gov. Hutchinson, Room 800 Bisbee Bldg., Jacksonville, Fla.

CHRYSTAL DETECTOR.—For mounting a plurality of rectifying crystals in such manner that a change in detecting may be easily made and the sensitive points found with great precision. Patent 1617956. L. Lane, Box 1066, Habana, Cuba.

ELECTRIC CIGAR LIGHTER.—Which makes use of a reel, similar in action to the window shade roller, for rewinding the cable after the heating element has been used. Patent 1617344. J. R. O'Neil, P. O. Box 3663, San Francisco, Calif.

ELECTRIC SWITCH.—For use in connection with brake operating devices, or automobiles, so constructed that the switch may be actuated independently, or simultaneously with a lever. Patent 1617324. R. H. Conty, 1122 Hydepark Blvd., Chicago, Ill.

ELECTRIC VALVE-OPERATING GEAR.—Which eliminates the usual valve operating cams and gears, and the liability of various operations occurring in internal combustion engines, getting out of time. Patent 1618,937. J. L. MacPherson and E. N. Sorensen, c/o E. N. Sorenson, 144 W. 123rd St., New York, N. Y.

Of Interest to Farmers

GRAIN SEPARATOR.—Which has means for thoroughly breaking up masses of straw and for causing the grain to fall at intervals from the straw and chaff. Patent 1617246. H. O. Freeman, R.F.D. No. 1, Eden, Idaho.

CULTIVATOR ATTACHMENT.—For a multiple gang plow, the attachment being directly fixed after the shares have been removed, and manipulated in same manner as the plow. Patent 1616417. G. Hamersley, Box 104, Geyserville, Calif.

LAP LINK.—For plows and like agricultural implements, adapted to connect a whiffletree hook with a clevis, or like connection at the end of a beam. Patent 1619,519. E. Kelly, 1902 Dooley Ave., Anniston, Ala.

Of General Interest

SANITARY BEDBUG TRAP.—Having an interior portion in which the bugs may hide, the trap being removable for purpose of destroying the bugs. Patent 1614157. L. E. Schneider, 305 S. Main St., Galena, Ill.

SOUND-AMPLIFYING DEVICE.—A cabinet with doors at both sides, in which a radio receiving set and a loudspeaker or amplifier may be housed. Patent 1614983. P. H. Fuller, Emporium, Pa.

FASTENING DEVICE FOR CAPS.—For fountain pen cases, pencil cases, clinical thermometers, and the like, eliminating the use of threaded parts, and their tedious manipulation. Patent 1614048. W. E. Stewart, c/o Eisele Co., Nashville, Tenn.

COMBINED VANITY COMPACT AND CIGARETTE CASE.—Adapted to be suspended from the wearer's arm, permitting free use of both hands for the removal of the parts, and applying the contents. Patent 1614374. S. Q. Lupo, c/o Columbia Manicure Mfg. Co., 3636 Park Ave., New York, N. Y.

COMBINED CABINET AND TABLE.—In which the shelves of the cabinet constitute the leaves of the table and are supported for movement to a horizontal position when not in use. Patent 1613294. C. W. Sanders, c/o Security Trust & Savings Bank, 502 South Spring St., Los Angeles, Calif.

ROUGE.—Which will fit any complexion, from darkest brunette to lightest blond, and will not wash off except by the use of cold cream or soap. Patent 1614211. R. H. Sharp, 4357 Cottage Grove Ave., Chicago, Ill.

FLOOR AND CEILING CONSTRUCTION.—Formed by a series of similar structural units accommodating a cementitious binding material to produce a monolithic structure, principally for use in dwellings. Patent 1615096. J. J. R. Meyers, c/o Mrs. Robbins, 140 W. 42d St., New York, N. Y.

MIXING VALVE.—Capable of controlling the discharge of fluids from a plurality of sources through a common discharge, as in the mixing of hot and cold water. Patent 1614437. C. C. Cochran, Box 197, La Cresentia, Calif.

REMOVABLE LADDER STEP.—A flat step which may be supported on the rung of a ladder and securely held in position to give ample foot support. Patent 1615135. S. Putnam, 32 Howard St., New York, N. Y.

FOLDING TABLE.—More particularly a card or small table which may be stored in minimum space, the legs being simultaneously shifted between folded and operative positions. Patent 1614539. T. J. Ryan, Box 641, Douglas, Ariz.

HAIR PIN.—Which has all the advantages of the ordinary hair pin in addition to being self-locking, especially adapted for use with bobbed hair. Patent 1614809. E. G. Sylvester, Model Sanitary Barber Shop, 180 So. King St., Honolulu, Territory of Hawaii.

EMBEDDED INKSTAND.—Adapted for tables, or desks, the inkwells being flush with supporting surface, and arranged to prevent foreign articles being accidentally forced into the ink. Patent 1615377. W. T. Guth, 149 Van Dyke St., Brooklyn, N. Y.

RAZOR CASE.—For use with various styles and sizes of razors, and is adapted to oil and condition the blades when they are not in use. Patent 1615396. C. D. Lorenz, 1408 1st National Bank Bldg., Pittsburgh, Pa.

BATHTUB MAT.—Which is self-retaining, affording means by which the bather may obtain a non-slip purchase to lift himself to an erect position. Patent 1615706. S. Johnstone, R. 2, Masonic Temple, Sparks, Nevada.

COMPACT EJECTOR FOR VANITY CASE.—Wherein a compact is normally held against removal but so associated with an ejector that the compact may be ejected with ease by the operation of the same button that unlatches the case. The inventor has been granted two patents of a similar nature, 1616375 and 1616376. W. G. Kendall, 118 Market St., Newark, N. J.

FOLDING BED.—Having spring means for swinging the bed frame into folded position and a dash-pot for preventing vibration as it closes. Patent 1615412. W. M. Simon, c/o Quality Metal Bed Co., 1800 So. Kilborn Ave., Chicago, Ill.

PIE CONFORMER.—Adapted to be placed in a conventional pie pan prior to and during the baking operation functioning to divide the pie into sections. Patent 1613,223. C. C. Davis, c/o C. Zenker, 188 W. 4th St., New York, N. Y.

SEALING JAR.—Comprising a jar and cover, of suitable material, in which the cover may be securely wedged into position, and sealed with an air-tight joint. Patent 1615519. S. F. Ralston, Box 458, Seal Harbor, Me.

FIRE LOCATER.—For determining the position of forest fires either by day or in the night without necessitating telephonic communication between several stations. Patent 1615507. P. W. Fisher, c/o Mrs. Fisher, Yreka, Calif.

SHAVING KIT.—So constructed that a tube of shaving cream and a conventional type of razor may be packed together in a minimum of space. Patent 1615743. F. E. Crandall and A. S. Vogel, c/o Arthur Vogel, 987 Lorimer St., Brooklyn, N. Y.

ARTIFICIAL BAIT.—In which the hooks are ordinarily guarded and the barbs housed, but become exposed upon the bait being taken by a fish. Patent 1615747. G. E. Fenner, Oxford, Wis.

VANITY CASE.—Whereby loose powder may be carried and prevented from accidental spilling but may be dispensed from the interior to a puff by pressure. Patent 1616,381. H. MacDougall, c/o W. G. Kendall, 118 Market St., Newark, N. J.

KEY HOLDER.—In which a plurality of keys and an identification card, may be conveniently supported in a flexible cover suspended from a belt or other apparel. Patent 1616302. J. Brewer, 1326 Hoe Ave., Bronx, N. Y.

VANITY CASE.—Having pressed out portions for receiving a resilient ring acting to clamp the compact plate in position. Patent 1616374. W. G. Kendall, 118 Market St., Newark, N. J.

VASE.—Comprising a main receptacle and a plurality of auxiliary receptacles removably connected to and supported by the main receptacle, and forming an attractive assemblage. Patent 1617280. P. Viggiano, Shinnston, W. Va.

DEVICE FOR TEACHING DRAWING.—For those receiving instruction as, for example, listeners into radio broadcasting, enabling the listener to locate successive points and to draw a line as directed. Patent 1617207. M. Fleischer, c/o Out of the Inkwell Films, Inc., 1600 Broadway, New York, N. Y.

LOCK JOINT FOR CONTAINERS AND METHOD OF PRODUCING THE SAME.—Particularly applicable to containers made from multiple ply material, establishing a strong connection between the meeting edges, precluding unauthorized opening and resealing without detection. Patent 1617274. M. C. Romer, 161 Rutland Road, Brooklyn, N. Y.

SAFETY RAZOR.—Of the autostrop type, so constructed that the edges of the blade will wear uniformly, if uniformly alternated relative to the guard plates. Patent 1617238. J. J. Earley, 443 Lincoln Place, Brooklyn, N. Y.

SMOKING-PIPE ATTACHMENT.—Which employs a cap for preventing sparks flying from the bowl, and an adjustable, resiliently held tamper for pressing down the tobacco. Patent 1617257. F. J. J. Lechleder, 1417 Green Ave., Brooklyn, N. Y.

SEAT OR HAT CHECK.—So formed as to identify the particular trip and time at which it was issued, thus precluding its subsequent use. Patent 1616660. C. T. Rabert, 915 12th Ave., Huntington, W. Va.

DOLL.—Having a multi-faced head for adjustment upon the body so that the doll may be readily converted from one type to another. Patent 1615401. H. T. Payne, Box 851, Sacramento, Calif.

COLLAR BUTTON.—Especially designed for permanent attachment to one end of the neckband of a shirt, thus eliminating the necessity of a detachable button. Patent 1617252. H. Horwitz, 3274 Bedford Ave., Brooklyn, N. Y.

EDUCATIONAL APPARATUS. — A self-instructing device, having attributes by virtue of which a person may become instructed in subjects such as arithmetic, history, etc. Patent 1617272. C. A. Peterson, Fairbanks, Alaska.

BUILDING CONSTRUCTION.—A device comprising forms for supporting concrete flooring while it is hardening, and for reducing the time in securing the "furring" to the ceiling. Patent 1616444. W. G. Forkey, 4203 W. Madison St., Chicago, Ill.

CONCRETE FORM.—A metallic form which may be securely although separately held, for receiving plastic concrete, providing air passages in the wall, and apertures for windows and doors. Patent 1617746. A. Denger, 205 Union Trust Bldg., Davenport, Iowa.

CIGAR OR CIGARETTE HOLDER.—Including a special form of guard, for catching the ashes, the guard when not in use may be telescoped with the holder. Patent 1616396. M. Smith, 1263 Vermont St., San Francisco, Calif.

WINDOW GUARD.—Especially intended for the windows of sleeping rooms, permitting effective ventilation, and preventing entry through the open window, foldable into small space in disuse. Patent 1618060. A. W. Cooke, 211 Newmann Bldg., Memphis, Tenn.

HAIR WAVER.—Whereby a double wave in the hair can be very readily produced with the expenditure of a minimum amount of time and labor. Patent 1618144. M. Banach, c/o Raven Beauty Shop, 2664 Grand Concourse, Bronx, N. Y.

SAFETY GAS COCK.—Having an auxiliary valve which is open so long as the hose leading to the stove is connected, but automatically closes upon disconnection of the hose. Patent 1618071. C. J. Ermentraut, 8947 204th St., Hollis, L. I., N. Y.

VANITY-CASE EJECTOR.—Wherein part of the hinge forms an ejecting structure for releasing the compact plate carried by the case. Patent 1618092. W. G. Kendall, 118 Market St., Newark, N. J.

TASSEL.—The inventor has been granted two patents for an ornamental tassel, in one of which the parts are securely held together by a tassel head, the other dispensing with the necessity for an inner core at the head. Patents 1618110 and 1618111. A. Sacks, c/o Novelty Cord & Tassel Co., 57 Hope St., Brooklyn, N. Y.

ROOFING COMPOUND.—Which can be applied to a roof or wall in plastic condition, and will form a hard, firm and durable covering, fireproof and waterproof. Patent 1618078. I. Gedarovich, 198 Hull St., Brooklyn, N. Y.

EGG BEATER.—For mixing liquid or semi-liquids, the operation being upwardly for a predetermined distance then downwardly and finally outwardly into a bowl, splashing being prevented. Patent 1616817. R. G. Maxwell, 1225 Myrtle St., Oakland, Calif.

MOP.—Constructed to permit of the easy reversal of the head, even while in use, so that advantage may be taken of both sides. Patent 1618252. A. G. Wheler, 511 Felder Ave., Montgomery, Alabama.

CLOSURE FOR CONTAINERS.—For rigid and semi-rigid collapsible containers, releasably retained in a closed position, and easily actuated for controlling the discharge of contents. Patent 1618926. W. P. Harrison, 3901 Williamsburg Ave., Richmond, Va.

ADJUSTABLE BRACKET. — Especially designed for supporting gas or electric meters or other devices of this nature, from a wall or other vertical surface. Patent 1618857. R. P. Barry, Box 262, Carle Place, Nassau County, N. Y.

SAFETY RAZOR.—Peculiarly suited for removing hair from hollows or depressions in the skin, as well as ordinary shaving on flat or convex areas. Patent 1618895. L. Taplinger, 1529 E. 23rd St., Brooklyn, N. Y.

CURLING IRON.—Including two cooperative jaw members whereby a relatively great number of strands of hair may be firmly gripped and uniformly crimped. Patent 1618306. A. B. Pederse, 1134 E. 17th St., Salt Lake City, Utah.

WATCH LOCK.—For preventing the removal of a watch from the pocket without first manipulating the lock, and for holding a fob in position. Patent 1618698. B. N. Colon, Greer College, 2024 So. Wabash Ave., Chicago, Ill.

MEAT HANGER.—Adapted for supporting slabs of bacon firmly, although releasably, without causing holes, while the meat is being smoked. Patent 1618833. H. R. Koll, 4417 So. 18 So. Side Station, Omaha, Neb.

PLASTER TERMINAL.—For utilization in connection with door and window openings, eliminating cracks and crevices, and thereby the leakage of air around such structures. Patent 1618695. I. A. Baum, Columbian Mutual Tower, Memphis, Tenn.

APPARATUS FOR TREATING THE ABDOMEN. —A pedal device, by which massaging of the abdominal region is effected through leg movements of the operator, and under control of the person taking the treatment. Patent 1618916. J. J. Cooper, 56 W. 47th St., New York, N. Y.

CRAMPING DEVICE.—For holding the body portion of a shoe upper stretched in shape, so that when removed from the block it will fit the foot smoothly. Patent 1618654. C. Gronski, Sheridan, Wyoming.

SUPPORTING HOOK.—Particularly adapted for workmen's use, the construction being such that the objects suspended, such as key cases, will not readily come off. Patent 1618573. C. F. Cole, c/o S. F. Hall, 588 Gratiot Ave., Detroit, Mich.

EYEGLASSES OR SPECTACLES. — Having reading lenses and auxiliary lenses, cooperable to provide distance lenses, the auxiliary lenses may be adjusted to permit of the reading lenses being used alone. Patent 1619659. J. T. Evans, Box 659, Boise, Idaho.

DISPENSING CONTAINER.—For the reception of somewhat oily or viscous liquids, such as hair oils or the like, conveniently dispensing without soiling the outside of the container. Patent 1619770. R. Stewart, 10914 108th St., Ozone Park, L. I., N. Y.

MILK CARD.—To be located at a convenient place to advise the milkman as to the desired quantity of milk or cream to be left. Patent 1619756. A. Pearson and D. N. Lindquist, Lindsborg, Kansas.

FASTENING DEVICE.—Primarily adapted for securing dust covers to the outer covering of upholstery in general, but particularly automobile seats and backs. Patent 1619,764. D. I. Reiter, 100 5th Ave., New York, N. Y.

PERMANENT-HAIR-WAVING APPLIANCE.—Consisting of two semi-cylindrical heating bodies mounted on scissor-like handles, for use in the waving of flat strands of hair. Patent 1619794. J. Mayer, c/o A. Kietz, 9710 Euclid Ave., Cleveland, Ohio.

CONCRETE WALL CONSTRUCTION.—Whereby concrete studding for hollow walls may be made integral with the walls and completed in one continuous spraying or plastering operation. Patent 1618421. N. Garrett, Mountain and Jackson Sts., Glendale, Calif.

BAIT BOX.—Having float chambers for keeping the box above the surface of the water, for easy access, but permitting a circulation of water therethrough. Patent 1619634. H. A. Roat, Lehigh Valley Police Dept., Manchester, N. Y.

MILK-BOTTLE PROTECTOR.—Having automatic locking means, actuated by the placing of the bottle in position, after which it is accessible only to the household. Patent 1619745. J. A. McNamara, 144-15 Hudson St., Springfield Gardens, L. I., N. Y.

BRUSH AND BROOM ATTACHMENT.—Easily applied to a brush or broom of standard construction, whereby the function of a mop is imparted with the normal brushing or scrubbing. Patent 1617764. T. H. Lawrence, Keamath Falls, Oregon.

COLOR CHART.—A sample display card for use by paint manufacturers for displaying their entire line at once by means of a small portion of each color. Patent 1618664. E. F. Kern, 301 Mission St., San Francisco, Calif.

COMBINATION VENT AND CLOSURE FOR CANS.—A puncturing and plugging device for use both as a vent and a dispensing means for the contents of evaporated milk, cream, and olive oil cans. Patent 1618694. C. W. Bassett, 1245 Broadway, Alameda, Calif.

Hardware and Tools

CLIPPING DEVICE.—Especially designed for use in gathering fruits, vegetables and flowers, as well as for light pruning, operable by the wrist movement of one hand. Patent 1616447. W. Gower, R. 2, Box 432, Tampa, Fla.

FOLDABLE SQUARE.—In which the legs are rigidly locked against movement when in extended position, but when folded occupy the space of but one leg. Patent 1616457. J. A. McWilliams, 6749 S. Green St., Chicago, Ill.

ATTACHMENT FOR SHEARS.—Which positively insures the proper correlation of the cutting edges, irrespective of whether the same are manipulated with the right or left hand. Patent 1618082. R. P. Hafner, 215 4th St., Passaic, N. J.

SAWING DEVICE.—Which is flexible to permit of its being conformed to the contour of the object being sawed, and which it is embracing. Patent 1616880. C. J. Swanstrom, Box 43, Coronado Beach, Calif.

SAFETY HOOK.—Designed for holding and locking a rope, chain, eye or other object, by means of a special form of latch which closes the bill. Patent 1618321. B. Woods, c/o Algyre Machine & Tool Co., Holdenville, Okla.

CIRCULAR SAW.—A manually operated disk saw, particularly suited for cutting out sections of flooring, ceilings, partitions, etc., for installing electric wires or similar apparatus. Patent 1619780. F. W. Adlof, 912 6th Ave., New Brighton, Pa.

TOOL HOLDING ATTACHMENT FOR POCKETS.—Which when associated with the tool receiving pocket of overalls will maintain the pocket in a manner to prevent accidental displacement of the tools. Patent 1618492. F. W. Taylor, 1955 South Mariposa St., Los Angeles, Calif.

BEAM COMPASS.—In which the points are individually adjustable so that they may be positioned at different levels and with the beam parallel. Patent 1619750. E. Nelson, 564 Conn St., Gary, Ind.

Heating and Lighting

OIL BURNER.—For domestic use, capable of using different grades of oil, and wherein the oil is gravity fed, with means for preventing a flooding of the burner. Patent 1613820. G. B. Dahl, c/o Dahl Oil Burner Corp., 100 Broadway, New York, N. Y.

STEAM TRAP.—Adapted for use in removing water of condensation from steam lines, heaters, engine drains, separators of compressed air, or fluids of different specific gravities. Patent 1618081. A. L. Grandstaff, 34 North Union St., Akron, Ohio.

GAS HEATER. — Whereby a maximum amount of heat can be deflected and directed into the lower portion of a room from a given consumption of gas. Patent 1618169. A. T. Broch, Box 425, City Hall Station, New York, N. Y.

SMOKE DAMPER.—In which a novel damper assemblage is provided of a character designed to prevent the escape of heat from a boiler furnace. Patent 1618905. F. Baentsch and A. Stober, c/o G. Hirschfeld, 134 Alexandrinenstrasse, Berlin, S.W., Germany.

STEAM-APPLYING DEVICE.—For revivifying cloth and crape material which cannot be conveniently pressed without losing its crinkle and original appearance. Patent 1617755. S. A. Gott, 285 4th St., San Francisco, Calif.

OIL BURNER.—Which may be used in a furnace for burning waste oil, such as lubricating oil from automobile crank cases, practically non-inflammable until vaporized. Patent 1619738. H. A. Lacerda, 330 1st Ave., Watervliet, N. Y.

LAMP.—Useful for miners, or physicians who may secure the lamp to the front of their heads, leaving the hands free, the light rays falling at desired points. Patent 1619,213. J. F. Menzel, c/o Knights of Columbus Hotel, 51st St. and 8th Ave., New York, N. Y.

Machines and Mechanical Devices

CLUTCH FOR POWER TRANSMISSION.—Whereby in the driving of one element by another a clutch disposed therebetween will slip when more than a predetermined amount of resistance is offered. Patent 1614370. J. Kubicek, 345 Nepperhan Ave., Yonkers, N. Y.

DUPLICATING MACHINE.—Wherein a rockable member provides for a printing operation upon each rocking movement, the parts may be nested in a container when not in use. Patent 1615084. H. A. Irwin, 280 10th St., Brooklyn, N. Y.

BRAID-SPREADING MACHINE.—Wherein one or a comparatively large number of braids may be simultaneously and quickly spread to different widths according to the machine set. Patent 1615162. L. Brandt, 521 E. 72d St., New York, N. Y.

RIVETING MACHINE.—Especially adapted for use in connection with brakes and brake band linings, although not limited to this particular use, the device is small and air operated. Patent 1615724. H. W. Pierce, 114 So. Montana St., Butte, Mont.

FRUIT AND VEGETABLE SQUEEZER.—Which will break up the fruit or vegetables, then discharge the skins and pits at one point, and the liquid and soft parts at another. Patent 1615734. G. Alfisi, 341 36th St., Brooklyn, N. Y.

HEAD MOTION FOR LOOMS.—Having a chain cylinder so designed that chains of varying lengths and widths can be run at

the same time, and controlled in perfect alinement. Patent 1615736.

CHOKER HOOK.—Such as used in lumbering, so constructed that the cable, ferrule or knob be actually placed within the body of the hook, thus eliminating accidental displacement. Patent 1615528. S. B. Stewart, 220 So. King St., Centralia, Wash.

MOTION-TRANSMISSION MECHANISM.—For transferring rotary motion from a high speed shaft to a means to be driven at a reduced speed, which may be varied, and in different directions. Patent 1616369. L. C. Hartmann, 56-20 Toledo St., Elmhurst, N. Y.

MULTIPLE-SPEED-TRANSMISSION MECHANISM.—Whereby a large number of different speeds may be obtained in a very simple manner, and by one operation. Patent 1616342. H. G. Altvater, 1818 Grove St., Richmond, Va.

LUBRICATING DEVICE.—Whereby a force feed grease cup may be filled without removing it from its position relative to the mechanism which it lubricates. Patent 1616425. F. B. Fink, 405 Lexington Ave., New York, N. Y.

UNIVERSAL SAWING OR CUTTING MACHINE.—Having a circular blade supported and propelled from above and designed to move back and forth over the work bench which may be raised or lowered. Patent 1615901. C. J. Carlson, Lexington Apt., Helena, Mont.

PROPELLING MECHANISM. — Which will climb and move over any obstruction, take any grade, move in any direction and travel over land and through water. Patent 1617261. H. B. Maksabedian, 567 Woody St., Waltham, Mass.

WELL DRILL.—Having means whereby a sample of the formation may be taken at any time and prevented from loss during its withdrawal from the well. Patent 1617043. O. M. Carter, 206 Scanlan Bldg., Houston, Texas.

PISTON RING.—Which produces an automatic oil feed-back action thereby preventing fouling of the spark plug and providing adequate lubrication for the wrist pin. Patent 1617229. E. G. Young, c/o Mrs. Young, 112½ E. Church St., Decatur, Ala.

AUTOMATIC COAT-HANGER-FORMING DEVICE.—Constructed to receive wires of desired lengths, and completely form strong and serviceable garment hangers with great rapidity. Patent 1616452. R. Knable, 507 W. 32nd St., Chicago, Ill.

VARIABLE-SPEED TRANSMISSION.—So constructed that the speed ratio may be changed without any gear shifting, and the direction of motion changed by a sliding motion of the friction wheels. Patent 1615432. J. L. Allen, 4520 15th Ave., Sacramento, Calif.

LUBRICATOR.—Wherein desired quantities of lubricant may be fed to one or a large number of points under pressure from a single reservoir. Patent 1617219. A. H. Oelkers, 622 Sheridan Square Blvd., Evanston, Ill.

SIGN-CHANGING EXHIBITOR.—Wherein a number of signs are stored within a cabinet and automatically exhibited, a special type of holder permitting the use of thin card or paper. Patent 1617308. A. G. and R. Mariolle, c/o Ideal Strap Co., 527 E. 133rd St., New York, N. Y.

WIRE-FEEDING DEVICE.—Especially adapted to feed wires one at a time, and drop them at predetermined periods during the operation of a coat-hanger forming machine. Patent 1616453. R. Knable, 507 W. 32nd St., Chicago, Ill.

CURTAIN-SIGN EXHIBITOR. — Wherein a plurality of sign rolls are contained within an illuminated apparatus and automatically unrolled one after another for display at a viewing panel. Patent 1617307. A. G. and R. Mariolle, c/o Ideal Strap Co., 527 E. 133rd St., New York, N. Y.

PUMP.—Wherein a single plunger operates in conjunction with an arrangement providing in effect two working chambers, and produces a maximum flow of water. Patent 1617853. P. J. Leithauser, 509 Nicholson St., Defiance, Ohio.

BRAIDING ATTACHMENT.—Readily adjustable to the foot of a sewing machine, and positioned to the needle so that the braid is in direct line of vision. Patent 1616637. N. A. Rankin, 524 30th St., Oakland, Calif.

WEIGHING CONVEYER.—For weighing loads on belt or other conveyers, such as used for the transportation of sacks or packages of material, or loose material. Patent 1617301. J. J. Reddick, deceased, Josephine H. Reddick, Administratrix, Los Angeles, Calif.

WAVE MOTOR.—Automatically actuated by impact of a wave, can be effectively installed in a sea wall, concealed to prevent damage by ships. Patent 1617571. S. B. Caldwell, 7030 Lacy Way, Oakland, Calif.

EGG-BEATER HOLDER.—Comprising a standard and an arm, a pivotal connection enables the arm to be thrown backward, and the beater withdrawn from the bowl. Patent 1617747. R. W. Douglas, Chico, Butte Co., Calif.

FRUIT TRAY CLEANER. — A machine, adapted to clean, in a short period, a large number of trays, as used in the fruit industry, during the drying process. Patent 1617,756. D. H. Gray, Armona, Kings Co., Calif.

LUBRICATOR.—Which embodies a plurality of grease guns, all simultaneously operable to supply a desired number of machine bearings with lubricant, by force. Patent 1619,779. M. L. Adams, 296 So. Lake Ave., Pasadena, Calif.

CHANGEABLE EXHIBITOR. — An intermittently movable exhibiting device, whereby views may be thrown upon a screen through a continuously rotating power and the light masked during picture changes. Patent 1619155. G. R. Price, c/o W. E. Price, Galveston, Texas.

APPARATUS FOR FEEDING FOLDED PAPER TUBES OR THE LIKE.—Removing one sheet at a time from the bottom of a stack of sheets so that there will be no sliding contact between the sheets. Patent 1619711. E. Engstrom, Lindley Ave. and N. 13th St., Philadelphia, Pa.

HAIR-COLLECTING ATTACHMENT FOR CLIPPERS.—By means of which, hair as it is clipped is removed from the clipper, by air suction, and conveyed to a remote receptacle. Patent 1618713. J. L. Kaufmann, Los Angeles, Calif.

TYPE-BAR MECHANISM.—Which reduces materially the vertical dimension and relieves the gear teeth of the type bar and sub-lever of all strain at the start of operation. Patent 1619391. A. N. Woodruff, Box 1907, Washington, D. C.

Medical and Surgical Devices

OBSTETRICAL DEVICE.—Including a pair of separable handle and carrier members having eyes at their forward ends through which are passed a flexible encircling loop of tape. Patent 1614679. E. Odell, Central City, Neb.

FASTENING MEANS FOR CLINICAL-THERMOMETER CAPS.—Co-acting with the case and eliminating the use of threaded parts, thereby avoiding tedious manipulation and the scarring of the thermometer, also adapted for fountain pens. Patent 1614807. W. E. Stewart, c/o Eisele & Co., Nashville, Tenn.

STEAMING DEVICE.—Having an adjustable steam-conveying member adapted to be placed upon the head, face, throat or chest of the patient for delivering low pressure steam. Patent 1616036. T. E. Fitzstad, 629 Pine Ave., Long Beach, Calif.

HYDRAULIC BLOOD ASPIRATOR FOR EMBALMERS.—Which permits the use of a bottle of ordinary design, by virtue of the fact that the fluid employed is siphoned through the regular neck. Patent 1617254. G. H. Hurst, Jr., 202 N. Main St., Sumter, S. C.

FILM MOUNT.—Having registering openings, for receiving and displaying X-ray negative films, together with space for certain indices as used by dentists. Patent 1617304. L. B. Groeschel, 40 W. 72nd St., New York, N. Y.

MEDICINE-DROPPER HOLDER.—Comprising a folded sheet having an adhesive material which may be applied to a bottle, the fold forming a tube for supporting a dropper. Patent 1618724. E. Pearson, 807 Ulloa St., San Francisco, Calif.

Railways and Their Accessories

RESILIENT STRIKER PLATE AND COUPLER CARRIER.—So designed that the coupler has the same play as in the ordinary car construction, but the plate is held by springs to withstand pressure. Patent 1610540. C. E. Wickersham, Box 13, Station B, Toledo, Ohio.

AIR BRAKE.—Whereby the use of the triple valve ordinarily employed is eliminated and operation of the system is entirely under the control of the engineer in the cab. Patent 1611083. A. Silvene, P. O. Box 1093, Victoria, B. C., Canada.

RAIL-ANCHOR TIE PLATE.—Which may be readily applied to a rail and secured by any system of spiking, and will prevent movement in any direction. Patent 1611,949. C. C. Ricker, Idd Apartment "K," Paducah, Ky.

FLUE SANDERS.—For entirely removing the carbon deposits or soot from the fire side of the tubing, flues and fire sheet of steam locomotives. Patent 1613638. G. Altimari and J. A. Campbell, c/o J. A. Campbell, 1401 Derr, Parsons, Kans.

STATION INDICATOR.—To give visual indication to passengers of a train of cars the station being approached, the device is operable from a central controlling point. Patent 1615153. E. Alessio, 559 Second Ave., Astoria, L. I., N. Y.

RAILWAY TICKET.—Easily adapted for any one of various purposes, thereby reducing the number of tickets necessary. The ticket precludes alterations which might defraud the company. Patent 1615100. W. M. Rogers, Whitesville, Ky.

TRACK-GAUGING DEVICE.—Provided with means for automatically indicating and registering any defect in the tracks, either in the form of spread or sunken rails. Patent 1615714. S. Magaton, 212 Sullivan St., New York, N. Y.

Pertaining to Recreation

WHISTLE PINWHEEL.—Wherein the whistle is sounded and the pinwheel rotated by the single act of blowing the breath, the device is simple and amusing. Patent 1613982. I. E. Cohn, 117 E. 24th St., New York, N. Y.

TEE.—For supporting golf balls, comprising an acorn cup, and a support in the form of a prong adapted to be forced into the ground. Patent 1614343. L. H. Broome, 33 Glenwood Ave., Jersey City, N. J.

FISHING LINE.—Sufficiently rigid to prevent the fish from throwing the hook, but under a predetermined strain bringing into play an elastic element which prevents snapping. Patent 1614642. E. J. Babbitt, 35 E. 8th St., Holland, Mich.

GAME APPARATUS.—By means of which a special type of battledore will drive a special form of shuttlecock for a considerable distance or height. Patent 1617243. T. Flanagan, 180 Winchester St., Rochester, N. Y.

Pertaining to Vehicles

COMBINATION VACUUM TANK AND REGISTERING DEVICE.—Which permits the car owner to keep account of the amount of gasoline used, and allows predetermined quantities to be fed. Patent 1611832. T. T. Givens, R. F. D. No. 3, Box 91, Merced, Calif.

APPARATUS FOR INDICATING THE LEVEL OF LIQUIDS.—Which can be conveniently located on the instrument board of an automobile and will show the quantity of gasoline in the tank. Patent 1613245. O. T. Nelson, R. F. D. No. 1, Wickliffe Heights, Wickliffe, Ohio.

VEHICLE BODY CONSTRUCTION.—Which greatly increases the strength without materially adding to the weight, and facilitates the removal and replacement of damaged parts in effecting repairs. Patent 1614401. J. Shakespeare, 215 East 35th St., Brooklyn, N. Y.

AUTOMOBILE WINDOW. — Which enables the driver of a car to carry out the hand signaling movements without being subjected to disagreeable exposure to rain or snow. Patent 1614189. D. H. Donachy, 952 Memorial Ave., Williamsport, Pa.

APPARATUS FOR CLEANING AND POLISHING AUTOMOBILES.—Whereby any number of automobiles may be successively and slowly conveyed along a predetermined path, and cleaned and polished before reaching a given point. Patent 1613213. L. J. Wilde and B. K. Gillespie, 1515 St. Andrews Place, Los Angeles, Calif.

WINCH ATTACHMENT FOR AUTOMOBILE REAR AXLES.—Adapted to be removably secured to a conventional rear axle for affording driving power, and does not interfere with the normal movements of the car. Patent 1613900. W. C. Nabors, c/o Nabors Garage, Mansfield, La.

BRAKE FOR MOTOR VEHICLE.—Which may be set very gradually or quickly, but in no instance with an abrupt stop which would cause discomfort to the occupants. Patent 1614119. S. Giovannini, 658 N. La Salle St., Chicago, Ill.

ANTISKID DEVICE.—Which includes elements having pointed spurs for more effectually biting into the road-bed, the spur elements being removable for replacement when worn. Patent 1615154. G. R. Anderson, c/o Eklund, 2743 Humphrey St., East Elmhurst, L. I., N. Y.

MOTOR-FUEL-TESTING COMPOSITION.—Which will rapidly determine the fitness of fuel for motors, without any study or experience, and without a chemical laboratory. Patent 1615143. V. Serravallo and E. Weis, c/o V. Langmann, 97 6th Ave., New York, N. Y.

AUTOMOBILE DOORLOCK.—Operated by a direct thrust, as opposed by the usual method of turning the handle, the device is protected against accidental operation. Patent 1614656. M. D. Corell, 527 W. 135th St., New York, N. Y.

ATTACHMENT FOR AUTOMOBILE HOODS.—By which the contour of the hood may be changed from sloping to horizontal hinged sleeves and a hinged rod permitting the sections to be independently moved. Patent 1613912. A. J. Smith, 1831 Redesdale Ave., Los Angeles, Calif.

OIL GAUGE FOR MOTORS.—Supported by an automobile motor on the exterior thereof, having direct communication with the oil sump, for indicating the level of lubricant in the crank case. Patent 1615762. A. Kapitowitz, 508 Hegman Ave., Brooklyn, N. Y.

DEVICE FOR INFLATING AND DEFLATING PNEUMATIC TIRES.—Which may be set to supply tires with any number of pounds of air pressure, one automatic signal sounding during inflation, and another on the escape of air. Patent 1615943. W. A. Harris, 238 John St., Greenville, S. C.

AUTOMOBILE MIRROR SYSTEM. — So arranged that the driver, without turning his head, may at all times have an unobstructed view of the road directly behind him. Patent 1617270. C. W. Paup, 751 5th Ave., New York, N. Y.

SPRING EQUALIZER.—A link mechanism which not only allows the spring to contract and expand, but also allows the end to move toward or away from the chassis. Patent 1615376. C. C. Goodrich, 639 Turk St., San Francisco, Calif.

VEHICLE VENTILATING APPARATUS. — A device manually regulated by the driver for assuring a continuous removal of vitiated air and an inflow of fresh air without noticeable draft. Patent 1618152. E. B. Hutchins, 245 Pine St., Bangor, Me.

SHOCK ABSORBER.—In which the plunger operates in a fluid holding cylinder, novel means being provided to control the passage of the liquid through the plunger on the up and down strokes. Patent 1616091. B. Scott, 103 Broadway, Oakland, Cal.

LIQUID-LEVEL GAUGE. — Particularly designed to indicate, to the driver of a motor vehicle, by a graduated scale, the amount of gasoline contained in the tank. Patent 1617315. P. J. Lanson, 1548 Taylor St., San Francisco, Calif.

MUD GUARD FOR MOTOR VEHICLES.—Which includes a specially formed rubber strip, for preventing splashing, but which may be lifted when the vehicle is running outside a town. Patent 1618919. E. F. Dautevil, c/o C. Chassevent, 11 Boulevard de Magenta, Paris, France.

Designs

DESIGN FOR A MONUMENT.—Patent 71586. L. E. Hill, c/o Cross Bros., Northfield, Vt.

DESIGN FOR A CARD HOLDER.—Patent 71661. A. Dallek, 798 E. Tremont Ave., Bronx, N. Y.

DESIGN FOR A GLOBE FOR LIGHTING FIXTURES.—Patent 71802. W. Klehr, c/o E. F. Caldwell Co., 38 W. 15th St., New York, N. Y.

DESIGN FOR A MONUMENT DIE.—Patent 71831. L. E. Hill, c/o Cross Bros. Co., Northfield, Vt.

DESIGN FOR A SMOKER'S SET.—Patent 71755. M. M. Favish, c/o Bronze Metal Works, 361 W. Superior St., Chicago, Ill.

DESIGN FOR A CANDY BOX OR THE LIKE.—Patent 71887. F. A. Purchas, McGraw, N. Y.

DESIGN FOR A CURTAIN POLE.—Patent 71939. J. O. Crawford, c/o John Kroder & Henry Reubel Co., 107 E. 17th St., New York, N. Y.

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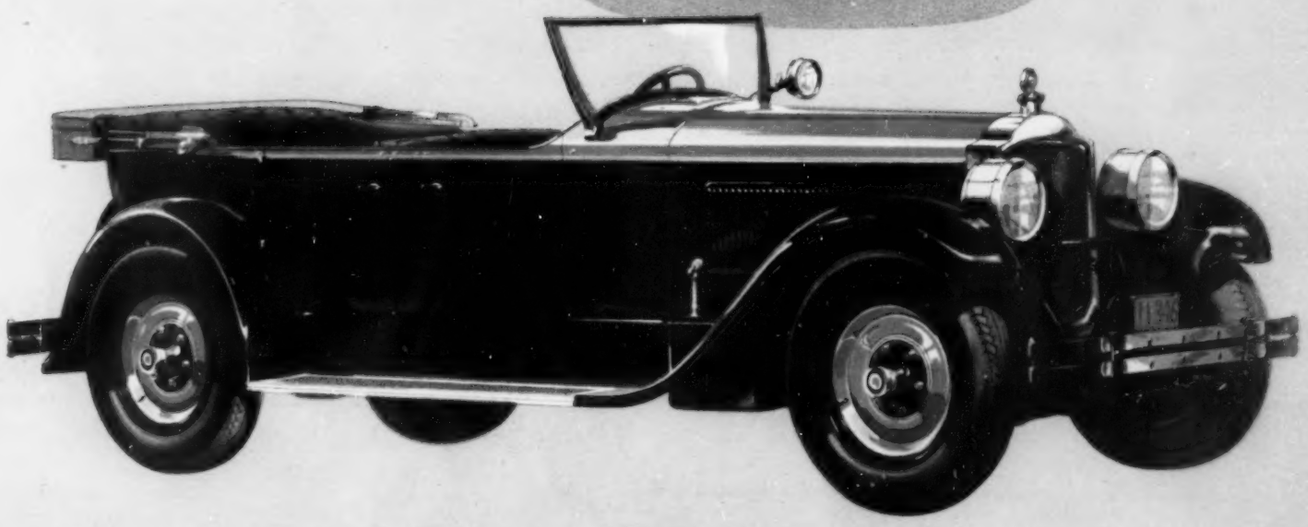


POWER — The soft purr of the Packard motor hardly hints its vast reserve power. Yet a touch of the accelerator and the great car leaps forward with the eagerness of a living thing.

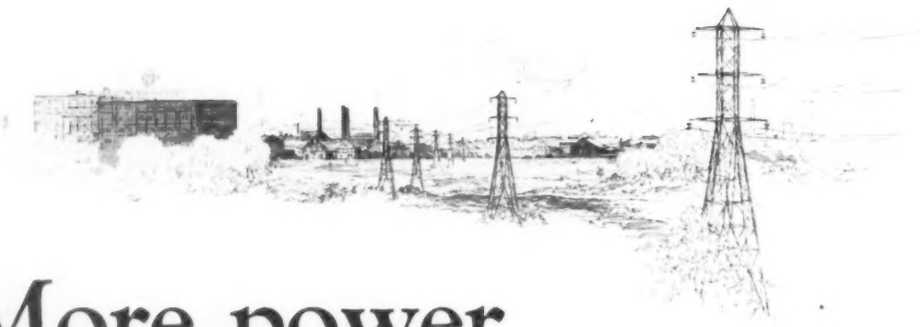
In its swift response to the driver's will lies the promise of superb and sustained performance. Mile after mile through the starts and stops of the crowded city, hour after hour on the long pull of the mountain grade, the Packard proves superior to all requirements—Packard power now reigns supreme.

Packard design—widely imitated but never equalled—has long been recognized as an outstanding combination of smartness, beauty and comfort. And Packard power—now unsurpassed in any motor car—offers matchless traffic agility, hill climbing ability and, when emergency demands it, *speed.*

Packard distinction—Packard power! A combination which has restored to many thousands of new owners their waning zest in motoring.

PACKARD

ASK THE MAN WHO OWNS ONE



More power and higher wages

ON MANY occasions we have told what electricity has done for other industries. This is the story of what electricity has helped us to do in our largest factory, at Schenectady.

In 1925 the plant used 93,000,000 kilowatt hours of electric energy as against 45,000,000 in 1914. An increase of 107%. On an average each worker received 111% more than in 1914.

With more power supplied to the worker he produces more with less effort, and is thereby enabled to earn more money and improve his standard of living. This is the fact which most impresses visitors—high wages going hand in hand with more power—because every worker is, in fact, a foreman profiting from the labor of the electrical manpower under his control.

Improvements in design, better methods of manufacturing, and numerous suggestions from workmen in various plants of the General Electric Company have resulted in lower production costs, which are reflected in lower selling prices. Motors, transformers, car equipments, and G-E MAZDA lamps are among the products recently so affected

GENERAL ELECTRIC